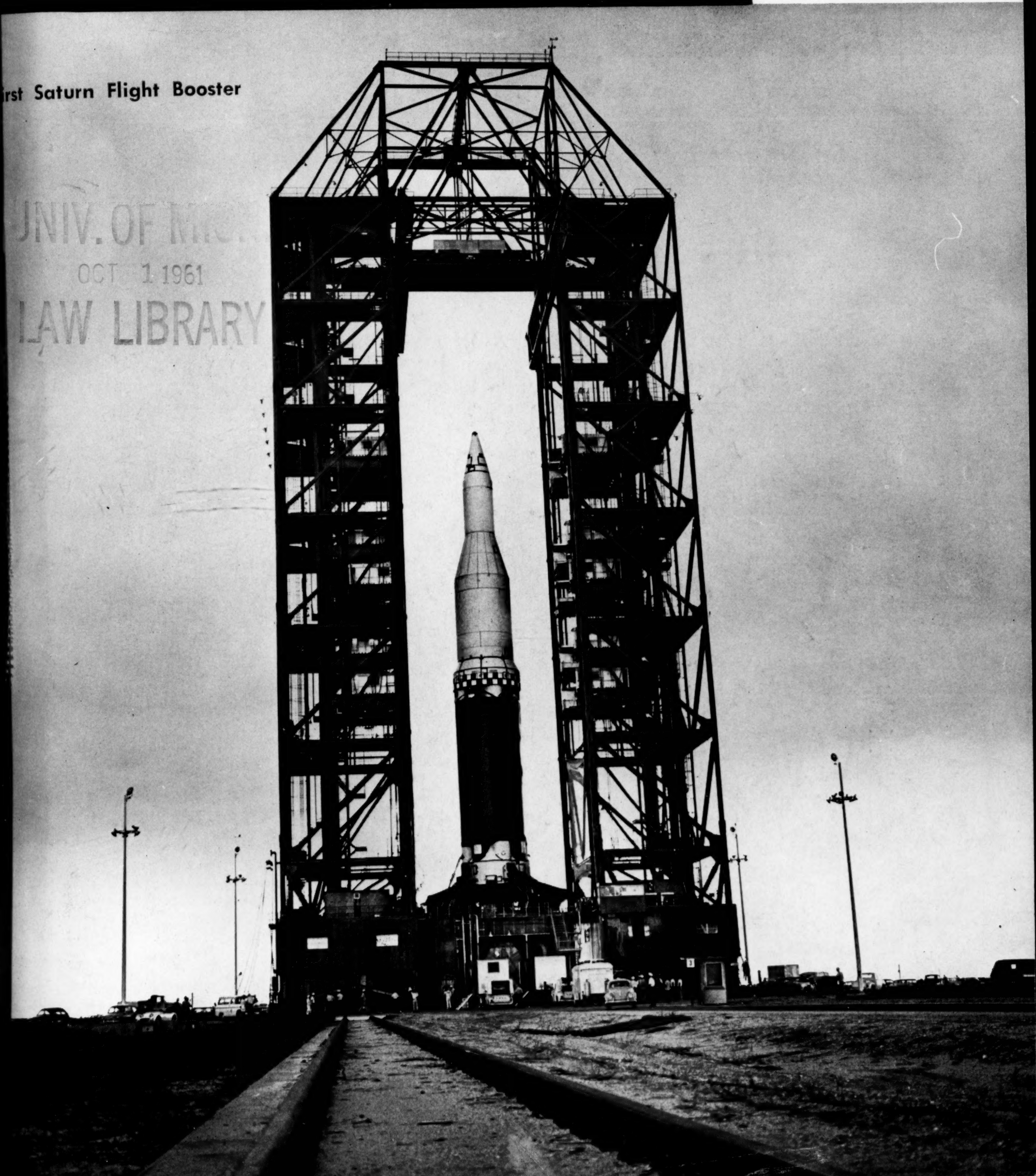
viation Week
and Space Technology

October 2, 1961

RE

SPECIAL REPORT:

Roving Lunar Vehicles



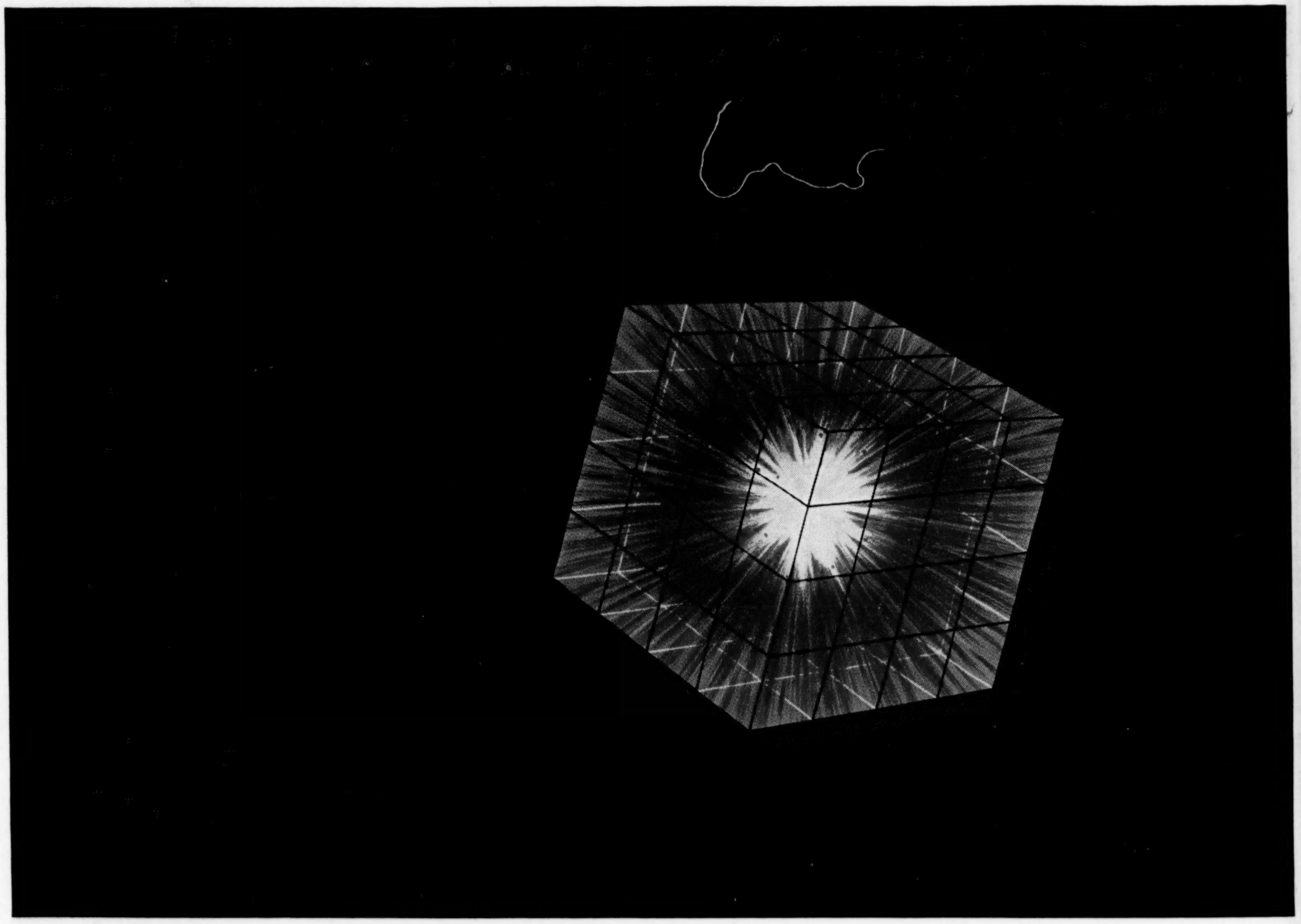
irst Saturn Flight Booster

UNIV. OF MIC
OCT 1 1961
LAW LIBRARY

The task of Aerojet-General's
Ordnance Division
is the sophisticated
manipulation of force.
Our ordnance research,
development, test,
and manufacturing facilities
are the finest
in American industry.

explosives control

WARHEADS / SAFETY AND FUZING SYSTEMS / COUNTERMEASURES
EXPLOSIVE FORMING / IGNITION SYSTEMS / CHEMICAL KINETICS
SEPARATION AND DESTRUCT SYSTEMS / AEROSOL PHYSICS
HYPERVELOCITY SYSTEMS AND RESEARCH



ORDNANCE DIVISION • DOWNEY, CALIFORNIA

Aerojet-General®
CORPORATION

A SUBSIDIARY OF THE GENERAL TIRE AND RUBBER COMPANY

Engineers, scientists: Investigate outstanding opportunities at Aerojet

AVIATION CALENDAR

Oct. 3-4—Air Force Science and Engineering Symposium, Sheraton-Palace Hotel, San Francisco, Calif. Sponsor: Air Force Systems Command in cooperation with Office of Aerospace Research.

Oct. 7—Open House to see Aerospace Exhibits, National Aeronautics and Space Administration, Langley Research Center, Langley AFB, Va.

Oct. 9-11—Mid-Year Conference, Airport Operators Council, Hilton Hotel, El Paso.

Oct. 9-11—National Electronics Conference, International Amphitheatre, Chicago, Ill.

Oct. 9-13—National Aerospace Engineering & Manufacturing Meeting, Society of Automotive Engineers, Ambassador Hotel, Los Angeles, Calif.

Oct. 9-13—1961 International Conference on Luminescence, New York University, New York, N. Y. Cosponsors: Air Force Aeronautical Research Lab.; Army Research Office; Office of Naval Research; New York University.

Oct. 9-15—American Rocket Society's 16th Annual Meeting & Space Flight Report to the Nation, Coliseum, New York, N.Y.

Oct. 9-15—Aircraft Owners & Pilots Assn. Convention, St. Petersburg, Fla.

Oct. 10-12—Second Conference on Nuclear Reactor Chemistry and Fifth Conference on Analytical Chemistry in Nuclear Reactor Technology, Gatlinburg, Tenn. Sponsor: Oak Ridge National Laboratory.

Oct. 14—13th Annual Reunion, U. S. Naval Test Pilot School alumni, U. S. Naval Air Station, Patuxent River, Md.

(Continued on page 6)

AVIATION WEEK and Space Technology

October 2, 1961

Vol. 75, No. 14

Published weekly with an additional issue in December by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Printed at Albany, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator; Daniel F. Crowley, Vice President and Controller. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

Available only by paid subscription. Publisher reserves the right to refuse non-qualified subscriptions. Subscriptions to Aviation Week solicited only from persons who have a commercial or professional interest in aviation, including missiles and space technology. Position and company connection must be indicated on subscription orders forwarded to address shown in box below.

Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada, $8 one year. All other countries, $20 one year.

Our primary aim is to provide subscribers with a useful and valuable publication. Your comments and suggestions for improvement are encouraged and will be most welcome. The publisher, upon written request, agrees to refund the part of the subscription price applying to the remaining unfilled portion of the subscription—if service is unsatisfactory.

Second class postage paid at Albany 1, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.

©Copyright 1961 by McGraw-Hill Publishing Co., Inc. All rights reserved.

Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK and SPACE TECHNOLOGY are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

Subscribers: Send correspondence and change of address to Fulfillment Manager, Aviation Week, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, including postal zone number. Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Fulfillment Manager, Aviation Week and Space Technology, 330 West 42nd Street, New York 36, N. Y.

Model GFD-3
Subcarrier Discriminator
Model GFD-4
High-Frequency Discriminator
Modular Accessories:
Model GFD-3/TASL
Model GFD-3/TSL
Model GFD-3/TU/LSM
Model GFD-3/TUA
DCS

The world's best Discriminators

. . . and our customers have proved it!

COMPARE THESE DCS FEATURES:

- **Super reliability – MTBF in excess of 5000 hours!**
- **Optimum phase-locked tracking – operator controlled.**
- **Widest frequency range – subcarriers to 1 mc.**
- **Maximum adaptability – widest variety of modular accessories.**
- **All solid-state – individual power supplies.**
- **YET – priced below many models with inferior performance!**

Don't just take our word – ask our customers, who are actually using thousands of DCS Discriminators!

For example, consider reliability. Actual field data gathered by users has shown MTBF in excess of 5000 hours! What's more, we guarantee our MTBF data!

Also, DCS offers operator-controlled variable-loop tracking filters. Unlike inferior discriminators which are limited to a pre-set loop bandwidth and damping (claimed "optimum"), DCS Discriminators permit complete operator control in adapting characteristics of the phase-locked loop for *truly* optimum data reduction. A bench demonstration will quickly prove the superior performance possible with operator control. Numerous comparative customer evaluation reports attest to the superiority of the DCS operator-controlled phase-locked loop when signals are extremely weak.

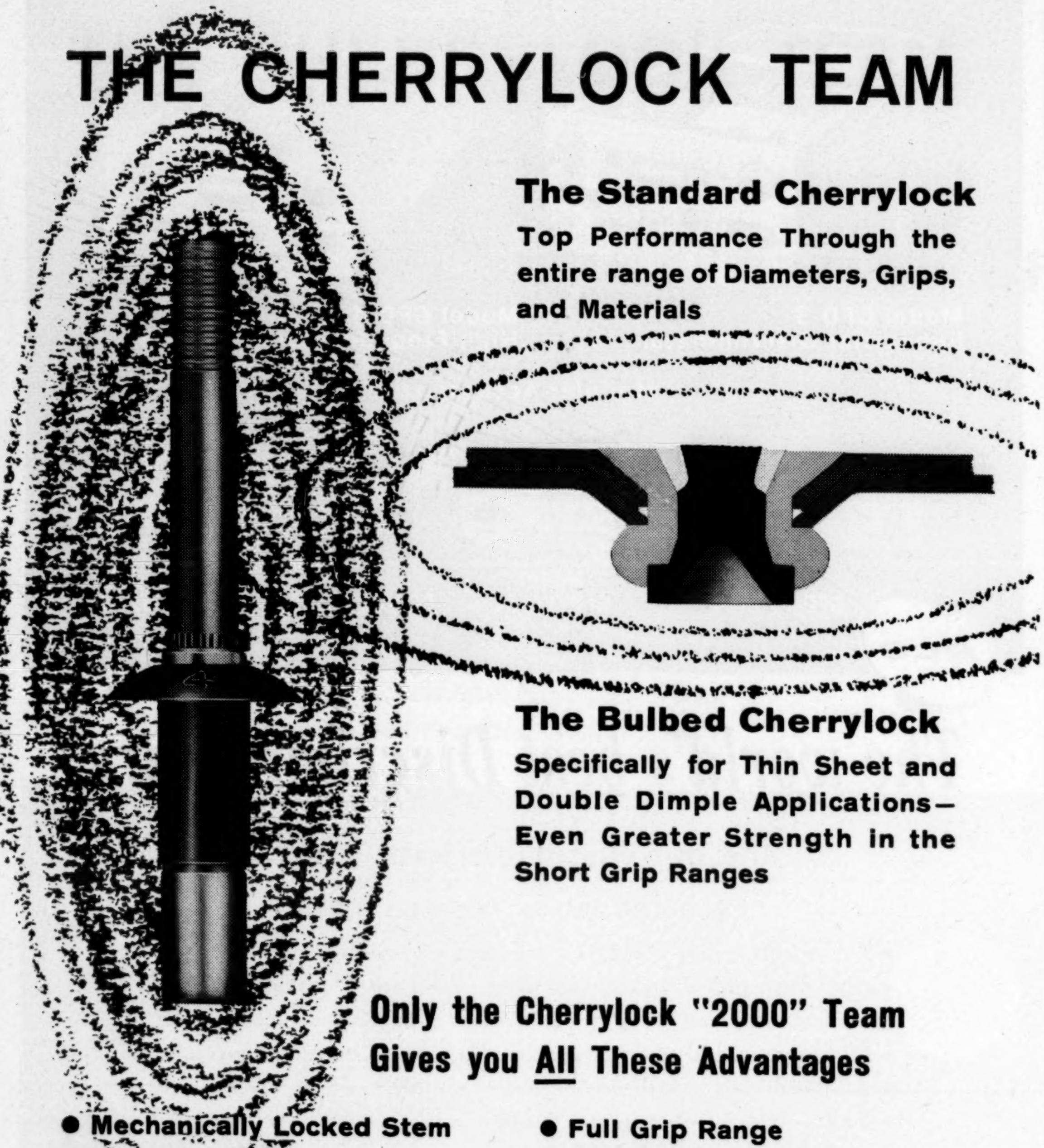
The DCS family of discriminators offers the widest frequency ranges available. Discriminators to accommodate subcarriers in excess of 1 mc, intelligence frequencies in excess of 100 kc, constant-bandwidth, frequency translation, and predetection signals are standard, off-the-shelf products.

For complete information on the entire family of DCS Discriminators and accessories, call your nearest DCS Field Engineer or write: Dept. AW-1-8.

Instrumentation for Research:
Ground and Air
Analog and Digital Data Components and Systems

DCS

DATA-CONTROL SYSTEMS, INC.
Los Angeles • Palo Alto • Wash., D. C. • Cape Canaveral
Home Office: E. Liberty St., Danbury, Conn. • Pioneer 3-9241

THE CHERRYLOCK TEAM

The Standard Cherrylock
Top Performance Through the entire range of Diameters, Grips, and Materials

The Bulbed Cherrylock
Specifically for Thin Sheet and Double Dimple Applications—Even Greater Strength in the Short Grip Ranges

Only the Cherrylock "2000" Team Gives you All These Advantages

- Mechanically Locked Stem
- Flush Fracture (No Stem Trimming)
- Positive Clamp-up
- Full Grip Range
- Complete Hole Fill
- Positive Visual Inspection (Grip Marked on Head)

A-286 Stainless Steel—Monel—Aluminum

The Cherrylock* "2000" series team offers the finest, most adaptable aircraft rivets yet developed. Maximum joint strength and reliability are obtained by using the Standard Cherrylock and the Bulbed Cherrylock to cover the entire range of applications. The Bulbed Cherrylock for short grips and double dimple, the Standard Cherrylock in the longer grips. Both types are installed with the same H-610 series pulling head, using existing Cherry guns.

Higher joint strength allowables, close blind side clearance, and the widest grip range available—only with the Cherrylock Team—result in better fastening at lower cost. The Cherrylock Team provides the strongest mechanical lock—flush fracture rivet available. Positive visual inspection after installation—with grip length marked on the rivet head—is offered only by the Cherrylock Team.

* * *

For technical data on the Cherrylock Team of rivets, write Cherry Rivet Division, Townsend Company, Box 2157-N, Santa Ana, Calif.

*Patent No. 2931532

A textron COMPANY
CHERRY RIVET DIVISION
SANTA ANA, CALIFORNIA
Townsend Company
ESTABLISHED 1816 • BEAVER FALLS, PA.
In Canada: Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario

AVIATION CALENDAR

(Continued from page 5)

Oct. 14-22—Federation Aeronautique Internationale 1961 General Conference, Hotel Quintandinha, Rio de Janeiro, Brazil.

Oct. 15-20—Fall General Meeting, American Institute of Electrical Engineers, Statler-Hilton Hotel, Detroit, Mich.

Oct. 16-19—Eighth Annual Symposium, American Vacuum Society, and Second International Congress, International Organization for Vacuum Science and Technology, Sheraton-Park Hotel, Washington, D. C.

Oct. 17-19—Lubrication Conference, Morrison Hotel, Chicago, Ill. Sponsors: American Society of Lubrication Engineers; American Society of Mechanical Engineers.

Oct. 18-19—Ninth Annual Safety Forum, Air Line Pilots Assn., Del Prado Hotel, Chicago, Ill.

Oct. 19—General Aviation Safety Committee, National Safety Council, Conrad Hilton Hotel, Chicago, Ill.

Oct. 23-24—Joint Meeting, Canadian Aeronautical Institute/Institute of the Aerospace Sciences, Ottawa, Canada.

Oct. 23-24—International Airline Navigators Council, European Regional Meeting, Paris, France.

Oct. 23-25—East Coast Conference on Aerospace and Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

Oct. 23-27—17th Annual General Meeting, International Air Transport Assn., Sydney.

Oct. 23-Nov. 3—William Tell 1961, USAF Interceptor Weapons Meet, Tyndall AFB, Fla. Host: Air Defense Command.

Oct. 24-26—Air Traffic Conference, Air Transport Assn., Marriott Twin Bridges Motor Hotel, Washington, D. C.

Oct. 24-26—International Symposium on Aero-Space Nuclear Propulsion, IRE, Riviera Hotel, Las Vegas, Nev.

Oct. 24-26—Air Transport Assn.'s Engineering and Maintenance Operators Meeting, Americana Hotel, Miami Beach, Fla.

Oct. 25-27—Annual Convention, Southeastern Airport Managers' Assn., Penn Hotel, Monroe, La.

Oct. 26-27—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Sahara Hotel, Las Vegas, Nev.

Oct. 26-27—Third Annual Symposium on High-Speed Testing, Hotel Somerset, Boston, Mass. Sponsor: Plas-Tech Equipment Corp.

Oct. 30-31—Aero/Space Fluid Power Conference, Pick-Fort Shelby Hotel, Detroit, Mich. Sponsor: Aero Hydraulics Division of Vickers, Inc.

Oct. 30-Nov. 1—Annual Meeting, Air Traffic Control Assn., Deauville Hotel, Miami Beach, Fla.

Nov. 1-3—"Issues and Challenges of Air Transportation" Symposium, Hartford, Conn. Sponsor: Connecticut General Life Insurance Co.

Nov. 6-8—Special Technical Conference on Non-Linear Magnetics, Institute of Radio Engineers, Statler Hilton Hotel, Los Angeles, Calif.

Nov. 6-9—1961 Conference and AtomFair, Atomic Industrial Forum and American Nuclear Society, Conrad Hilton Hotel, Chicago, Ill.

October 2, 1961

Aviation Week and Space Technology

Vol. 75, No. 14
Member ABP and ABC

EDITORIAL OFFICES: New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Nights LO 4-3035) **Washington 4, D. C.**—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630 **Los Angeles 17**—1125 West Sixth St., Phone: HUntley 2-5450 **Dallas 1**—1712 Commerce St., Phone: RIverside 7-9721 **European Office**—1 rue du Temple, Geneva, Switzerland, Phone: 32-35-63 **London Office**—34 Dover St., London W.1, England, Phone: Hyde Park 1451

PUBLISHER..........Robert W. Martin, Jr.
EDITOR..................Robert B. Hotz

MANAGING EDITOR........William Gregory
TECHNICAL EDITOR......David A. Anderton
EUROPEAN EDITOR.........Cecil Brownlow

BUREAU CHIEFS
WASHINGTON.................Evert Clark
LOS ANGELES................Irving Stone
DALLAS..................Erwin J. Bulban
LONDON...............Herbert J. Coleman

DESK EDITORS..............Harry Raven, Arnold Sherman, David A. Brown, Richard G. O'Lone
AVIONICS EDITOR..........Philip J. Klass
ASSISTANT...................Barry Miller
TRANSPORT EDITOR.............L. L. Doty
ASSISTANTS Glenn Garrison, Robert H. Cook, David H. Hoffman, Ward Wright
ENGINEERING.............Russell Hawkes, William S. Reed
SPACE TECHNOLOGY.....Edward H. Kolcum, George Alexander
MILITARY EDITOR............Larry Booda
BUSINESS FLYING.........Erwin J. Bulban, Andrew A. Keil
CONGRESS..............George C. Wilson, Katherine Johnsen
EQUIPMENT............James D. Hendricks
ART EDITOR.............Lawrence J. Herb
ASSISTANT....................Ann Dunphy
EDITORIAL PRODUCTION.....Frank Miazga
ASSISTANT EDITOR.........Edith Walford
EDITORIAL ASSISTANTS.....Marjorie Todd, Madge Hammond
LIBRARIAN.............Theresa V. Maggio

FOREIGN NEWS SERVICE
EDITOR.....................John Wilhelm
PARIS..................Robert E. Farrell
MOSCOW.....................Ernest Conine

DOMESTIC NEWS BUREAUS
ATLANTA 9.........1375 Peachtree St., N.E.
CHICAGO 11........645 No. Michigan Ave.
CLEVELAND 13..1164 Illuminating Building
DETROIT 26..........856 Penobscot Bldg.
HOUSTON 25....... W-724 Prudential Bldg.
SAN FRANCISCO 11......255 California St.

SALES
ADVERTISING SALES MANAGER
E. P. Blanchard, Jr.
ATLANTA...................R. H. Powell
BOSTON....................A. C. Boughton
CHICAGO and ST. LOUIS......J. S. Costello, D. C. Jackman
CLEVELAND..............T. H. Hunter, Jr.
DALLAS.......................John Grant
DENVER....................John G. Patten
DETROIT.......................M. Hulburd
HOUSTON........................J. Page
LOS ANGELES...........C. F. McReynolds, D. T. Brennan, C. A. Ransdell
NEW YORK.....................M. J. Storz, R. Wallace, J. D. Warth
PHILADELPHIA..J. D. Willis, J. M. Tannehill
PITTSBURGH.....................J. R. Pierce
SAN FRANCISCO..................R. R. Butera
PROMOTION & RESEARCH MGR..C. C. Gersna
EUROPEAN MARKETING DIRECTOR
Fulvio Piovano
RESEARCH & MARKETING
Rosalie Christesen, Patricia W. Abrams

BUSINESS
BUSINESS MANAGER........J. G. Johnson
CIRCULATION MANAGER........T. J. Lucey
ASST. BUSINESS MANAGER...W. V. Cockren
PRODUCTION MANAGER.........F. A. Dube

NASA Plans Centaur Acceleration................ 26

▶ Delays in development already have caused shift of mission; key programs dependent on vehicle.

Chances for Promotional Fare Plan Slim........... 36

▶ Lower North Atlantic rates proposed in mail ballot but approval before winter slump hits is doubtful.

Roving Lunar Surface Vehicles Studied.......... 52

▶ Impending need for mobile planetary vehicles to gather data and supply logistic support spurs investigation.

SPACE TECHNOLOGY

Centaur Acceleration Planned....... 26
GE Drops Satellite Bid............. 35
Roving Lunar Surface Vehicles Studied 52
Gamble on Tiros Is Paying Off....... 70

MISSILE ENGINEERING

Typhon to Enter Fleet in 1966...... 31

AERONAUTICAL ENGINEERING

Soviets Claim Helicopter Records.... 33
Production Briefing 82

AVIONICS

Telecommunications Treaty Ratified.. 35
Gyroscope Uses Spinning Liquid...... 75
Collins Offers PERT Program........ 79
Filter Center 79
New Avionic Products 81

BUSINESS FLYING

Beech to Produce Turboprop Plane.. 29
Riviera Amphibian to Be Sold in U. S. 83
Turbo-Flight to Sell Potez 840....... 84
Private Lines 85

SAFETY

CAB Report on Electra Crash........ 87

AIR TRANSPORT

Chances for Promotional Fares Slim.. 36
Foreign Competition Reappraised.... 37
Irish Airlines' Atlantic Market...... 38
Northeast Balks at Merger Terms..... 41
Examiner Approves Riddle Merger.. 41
CAB Proposes MATS Rate Changes... 42
FAA Orders DC-8 Landing Rule Change 43
Pacts Urged for SST Development.... 43
American, Flying Tiger Cargo Tariffs.. 45
ATC Reserve Proposed.............. 46
ALPA's Southern Stand Rejected..... 49
Pilot Voice Recorder Studied........ 49
Shortlines 47
Airline Observer 47

MANAGEMENT

Space, Defense Fared Well in Congress 27
USAF Aims at Space Supremacy..... 28
NASA Manager Policy............. 32
Herzfeld Named to Project Defender. 34
Who's Where 23
Industry Observer 23
Washington Roundup 25
News Digest 35

Calendar 5
Letters 98

EDITORIAL

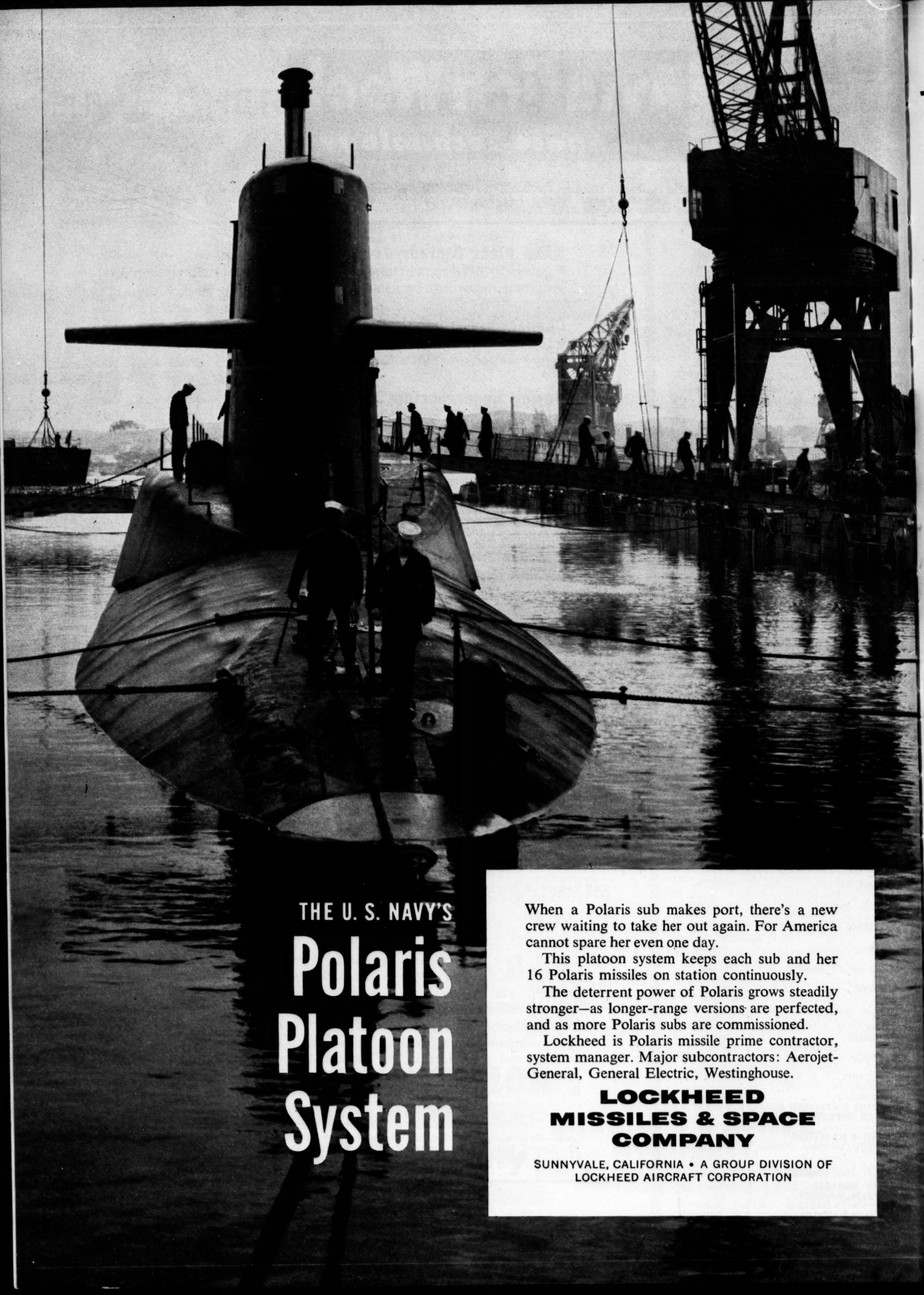
The Military Space Role—III........ 21

COVER: First Saturn flight booster at the Atlantic Missile Range Complex 34. The live booster, with inert second and third stages and payload, is about 125 ft. high. The booster is covered with a plastic "raincoat," which will be removed before launch, scheduled for next week. First flight will be a ballistic lob to an altitude of 100 mi. and range of 200 mi. National Aeronautics and Space Administration's Marshall Space Flight Center is building the first 11 boosters, and a contract will be awarded to an industrial firm for boosters No. 12 and beyond. This vehicle, designated SA-1, will develop 1.3 million lb. thrust. Operational Saturns will generate 1.5 million lb. thrust.

PICTURE CREDITS

Cover—Chris Butler; 33—Republic (top), Hughes; 34—Boeing Vertol; 52-57—Space-General; 53—General Motors; 55—General Electric (top, right), North American; 67—USAF; 70—RCA; 71—U. S. Weather Bureau; 73—NASA; 75, 77—Sperry Gyroscope; 83—Erwin J. Bulban.

85,806 copies of this issue printed



THE U. S. NAVY'S

Polaris Platoon System

When a Polaris sub makes port, there's a new crew waiting to take her out again. For America cannot spare her even one day.

This platoon system keeps each sub and her 16 Polaris missiles on station continuously.

The deterrent power of Polaris grows steadily stronger—as longer-range versions are perfected, and as more Polaris subs are commissioned.

Lockheed is Polaris missile prime contractor, system manager. Major subcontractors: Aerojet-General, General Electric, Westinghouse.

LOCKHEED MISSILES & SPACE COMPANY

SUNNYVALE, CALIFORNIA • A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

EDITORIAL

The Military Space Role—III

Since this series of editorials began early last month, the concern over defining and implementing the proper military role in the U. S. national space program has been growing. Last week in Philadelphia (see page 28), a distinguished forum of leaders in the space field emphasized again the growing military threat from the Soviet space program, and the folly of our initial approach into assigning top priority to non-military applications of space technology and excluding the military from pursuing a vigorous research and development program in this area adequate to meet the operational requirements that will inevitably be thrust upon it in the near future. We have also received a good deal of mail and comment indicating that many of our readers are equally concerned over this problem, although some of them apparently misinterpret our comments as a plea for complete military domination of the space effort.

Although in retrospect this might have been feasible during the immediate pre-Sputnik period when the military already had a considerable capability to handle this assignment, it is certainly not feasible now with the existence of the National Aeronautics and Space Administration. Nor is it really necessary to solve the problems created by the denigration of the military space role in the initial organization of NASA and the absurdities to which this intent has been carried in its early operations, particularly the Mercury program.

Management Unification

The requirements of NASA and a military space program have many similarities and many differences. What is really needed now is a management structure that effectively utilizes all of the current and future capabilities of both civil and military space organizations to explore all of the areas that both require, and to do all the applied research that both will need to develop operational systems.

Despite all of the various stabs at NASA-Department of Defense liaison during the past few years, no such effective management pattern has yet emerged nor is there any sign that it is likely to from current discussions. There is no effective interface between NASA and the Air Force organizations where the bulk of the military space research and development capability is concentrated.

The Department of Defense, in all of its various upper strata, must share considerable blame for this situation. Because of its top-heavy superstructure the Department of Defense handles all of its policy decision interfaces with NASA at a level far removed from the organizations and people within the military services who are most conversant with the military problems of space technology and who organize and operate the research, development and test facilities where the bulk of this work is being done. This will indeed be a difficult problem to solve because the Defense Department personnel now handling these vital matters are firmly convinced they are experts on the subject and that they are handling the problem well. They feel that the military space problem is a mirage seen only by blue-suited empire builders and myopic editors.

At an even lower level the military spacemen face another problem in the top echelons of the Air Force itself, where there is still an influential group working vigorously to prepare for World War II. It is convincing proof of the dynamic technology of our times that even the newest of the military services, in existence for little more than a decade, already has its core of die-hard conservatives holding fast to the technical environment in which they matured.

Budget Conscious

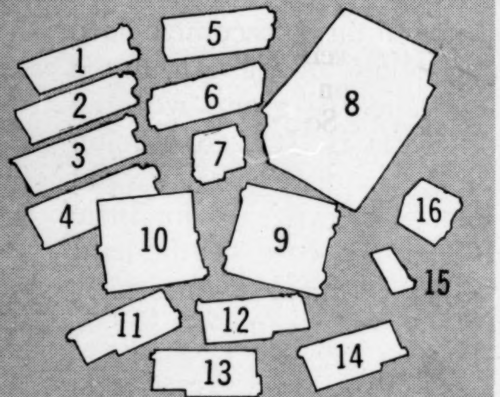
This "kick the tire" school views the new technologies with alarm and misgiving because of the increasing increments of the service budget they are absorbing and because of the possibility that they could force manned atmosphere-bound vehicles into a secondary military role.

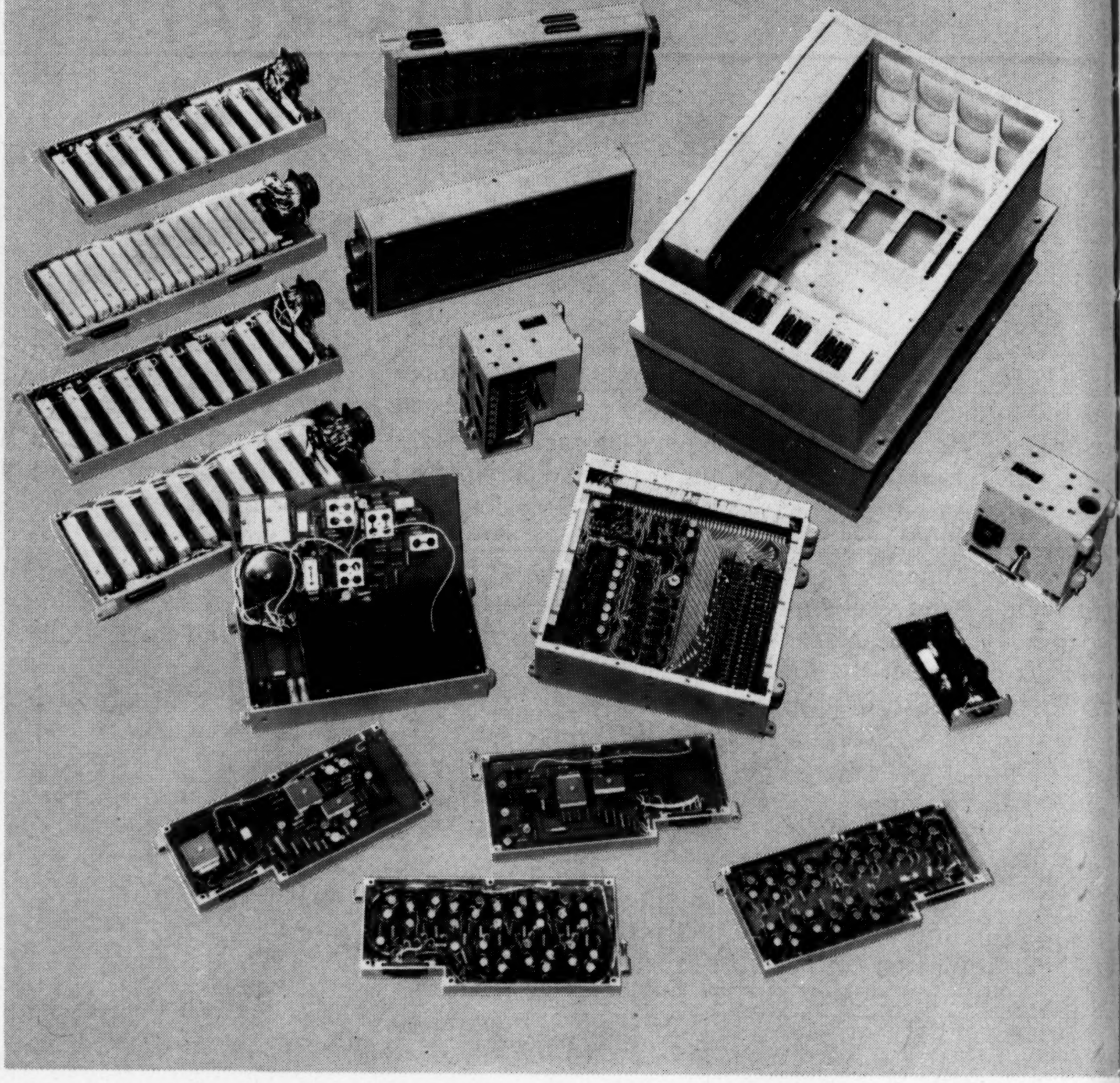
These military conservatives apparently want to wait until all of the basic research and development in space technology has been done by NASA and then decide at their leisure whether there are indeed any military applications of this technology. Unfortunately, the pace of these galloping technologies will not permit this type of approach without inviting inevitable national disaster. It should be obvious to all by now that the Soviets have clearly grasped the political and military implications of the new technologies and are pressing at the hardest pace within their capabilities to take full advantage of them.

What is really required to resolve the space problems that are pressing upon us so urgently is a basic new look at the goals of our national program and how we can best achieve them with the resources already available and those that must be obtained in the foreseeable future. Out of this new look must come a more effective planning and working liaison between NASA and the real military space leaders. Since neither the Department of Defense nor NASA is likely to take the initiative in this area, it appears to be an opportunity for the National Aeronautics and Space Council, in its new and vigorous form, to step in as the catalyst that is so badly needed.

—Robert Hotz

1-6	Commutator assembly—analog input
7	Digital input processor
8	Housing
9	Programmer
10	Low-level amplifier and super multiplexers
11-13	Analog to digital converter
14	Automatic, drift and gain compensation networks
15	Output filter
16	Power converter





NOW PCM TELEMETRY SYSTEMS
...for millivolt data inputs!

Now on short delivery schedules . . . Texas Instruments offers high accuracy pulse code modulation telemetry systems for millivolt, high level or combination inputs.

The complete PCM system shown is a lightweight, 0.9 cubic foot package that multiplexes and encodes 196 analog channels to eight-bit accuracy and processes six digital data inputs. Output information rate is 173,000 bits per second. The system's unique zero and full scale digital servo loop corrects system drift and gain change to assure overall system accuracy of ±0.4% in missile environments. Precision low-level electronic commutation is accomplished with less than ±20 microvolt offset error over a 0 to 70°C temperature range.

PCM encoding and decoding is only one of several advanced data link projects at TI. Others include millivolt oscillators, signal conditioners, solid-state transmitters, FM/FM systems, advanced microwave components, programmers, command and control systems, and space electronics. For detailed information on TI's capability to meet your particular requirements, contact MARKETING DEPARTMENT.

APPARATUS DIVISION
PLANTS IN DALLAS
AND HOUSTON, TEXAS

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE
P. O. BOX 6015 DALLAS 22, TEXAS

WHO'S WHERE

In the Front Office

Robert C. Jackson, president, Ryan Aeronautical Co., San Diego, Calif., succeeding **T. Claude Ryan** who continues as board chairman and chief executive officer.

I. Nevin Palley, executive vice president, Curtiss-Wright Corp., Wood-Ridge, N. J.

Cessna Aircraft Co., Wichita, Kan., has elected the following as senior vice presidents: **Frank A. Boettger**, to direct company-wide financial activities; **Delbert L. Roskam**, to monitor engineering, manufacturing and marketing functions.

Gerald A. Busch, vice president-marketing, Grand Central Rocket Co., Redlands.

Philip B. Taylor, formerly Assistant Secretary of the Air Force for Materiel, elected a director of General Precision Equipment Corp., Tarrytown, N. Y.

John C. Barnes, vice president, Hycon Mfg. Co., Monrovia, Calif.

Charles E. Ducommun, Los Angeles industrialist, a director of Lockheed Aircraft Corp., Burbank, Calif.

Kent R. Manning, a vice president of Aeroquip Corp., Jackson, Mich., has been named general manager of the newly formed Aircraft Division.

Richard C. Koperek, vice president and treasurer, Hallamore Division of Siegler Corp., Anaheim, Calif.

Jack G. Anderson, vice president-marketing, Kollsman Instrument Corp., Elmhurst, N. Y.

Peter J. Schenk, formerly executive vice president of The Mitre Corp., has formed his own company in Alexandria, Va., to specialize in defense management planning.

Herbert A. May, Jr., assistant to the board chairman of The Martin Co., Baltimore, Md. **Roland Carlson** succeeds Mr. May as assistant to the president.

Capt. Richard L. Duncan (USN, ret.), assistant to the vice president and chief scientist of United Aircraft Corp., East Hartford, Conn.

Sanford M. Harris has been appointed resident staff assistant in Western Europe for the Institute of the Aerospace Sciences, with headquarters in Brussels, Belgium.

George Moore, deputy director of the Federal Aviation Agency's Flight Standards Service, Washington, D. C., succeeding **George C. Prill**, who is now director of Flight Standards Service. **A. L. Coulter** replaces Mr. Moore as chief, Flight Standards Division of FAA's Southwest Region.

Col. Charles E. Carson, deputy commander, and **Col. Kenneth W. Gallup**, chief of staff, USAF's Office of Aerospace Research, Washington, D. C.

British Aircraft Corp., Ltd., London, England, has announced the following appointments: **Sir George Edwards**, managing director; the **Rt. Hon. Viscount Caldecote**, deputy managing director and chief executive (guided weapons); **Marshal of The Royal Air Force Sir Dermot Boyle**, responsible for coordinating the administration of personnel and training and education. Also: Sir George will become deputy chairman of Vickers-Armstrongs (Aircraft) Ltd. **A. W. E. Houghton** will succeed Sir George as managing director of that company.

INDUSTRY OBSERVER

▶ Five-stage Nova space vehicle is being considered by National Aeronautics and Space Administration Marshall Space Flight Center (AW June 19, p. 32). It would have eight 1.5-million-lb. thrust Rocketdyne F-1 engines in its first stage; eight 200,000-lb. thrust Rocketdyne J-2 engines in the second; two J-2s in the third; six 15,000-lb. thrust Pratt & Whitney LR-115s in the fourth stage, and two LR-115s in the fifth stage.

▶ Fluorine-hydrogen rocket stage known as Draco is being evaluated by Air Force and NASA for possible use on Atlas or Titan. It is being proposed by Space Technology Laboratories and Bell Aerosystems.

▶ Growth version of the USAF Minuteman solid propellant intercontinental missile is scheduled to be developed in time to be deployed in silos of the fifth wing. Boeing is to submit proposed final configuration to Air Force Systems Command by Jan. 1 and operational hardware is due to be ready by 1964. Ablative Avcote heat protection on the present version may be replaced by cork on the new version. First four Minuteman wings are scheduled for Air Force bases at Malmstrom, Mont.; Ellsworth, S.D.; Minot, N.D., and Whiteman, Mo.

▶ NASA is studying a three-stage, solid-propellant space vehicle based on its four-stage solid Scout and known as Ram. It would use an Aerojet Junior motor, which produces 57,000 lb. of thrust compared with Scout's 110,000-lb. thrust Aerojet Senior, as its first stage. Upper stages would be the Hercules-Allegany Antares and Altair, which are the third and fourth stages of Scout.

▶ Soviet turbojet engine for which India is negotiating for possible use in its HF-24 supersonic fighter is the VK-7, a follow-on to the Klimov VK-5 used in the Russian MiG-19 fighter. It is reported to offer performance comparable with the Bristol Siddeley Orpheus 12, which develops 8,170 lb. of thrust with afterburning. Company has flown the Orpheus 12 for about 25 hr. at its own expense but apparently is not ready to spend more without government support. India is objecting to paying development costs, estimated at about $4 million, if it is built in India under license.

▶ General Precision, Inc., has launched a company-financed research effort aimed at an all solid-state inertial guidance system that would have no moving parts and require no warm-up time. Company has been working on a nuclear spin gyroscope under Aeronautical Systems Division sponsorship for several years.

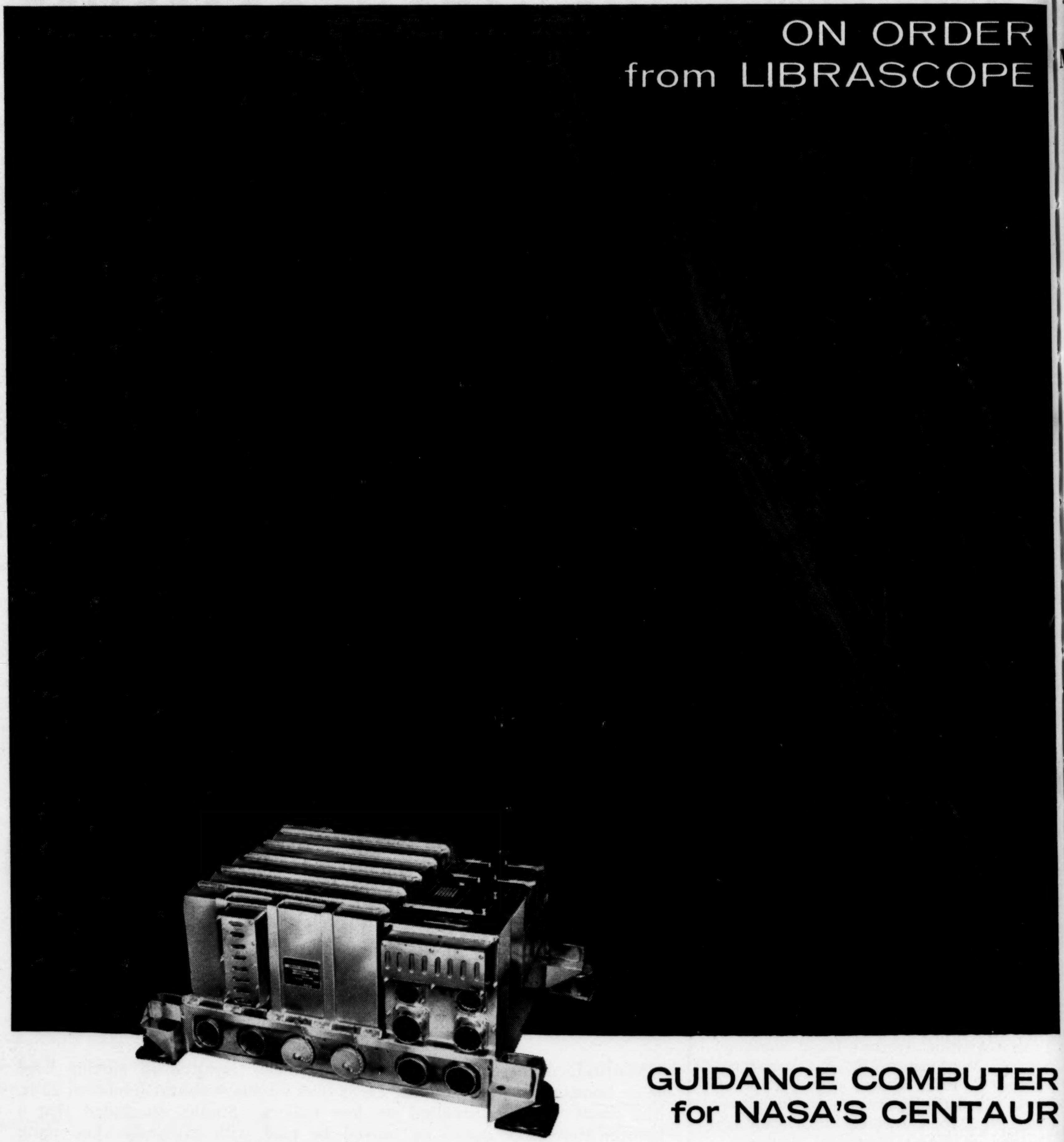
▶ Some NASA officials believe that astronauts should not begin training for Apollo missions until 18 months before expected flight time. Based on experience in the Mercury program, they feel that man is the most predictable part of the system and that Apollo spacecraft engineering should get the major emphasis for the next two years.

▶ Martin-Denver studies of logistics problems involved in moving large space boosters included sending crews over various routes with inflated 22-ft. dia. plastic balloons cradled on low trailers. Studies concluded that a booster that large could be moved by road with extremely close route planning, but only if some obstacles could be by-passed and a number of utility lines moved.

▶ Latest cost estimates on several major Air Force missile and satellite programs are running considerably higher than those made a year ago. USAF may be forced to request more funds than anticipated for Fiscal 1963 or prune heavily on other programs.

▶ Vought Astronautics is conducting a study of the launch-from-orbit technique for NASA. Study is known as OLO, for orbital launch operations.

▶ Midas III infrared early warning satellite, launched last July 12 from Pt. Arguello, Calif., attained a near-perfect circular polar orbit at a 2,128-mi. altitude. Eccentricity is 0.000127 and period is 160.93 min. Inertial velocity was 14,266 mph.



ON ORDER
from LIBRASCOPE

GUIDANCE COMPUTER
for NASA'S CENTAUR

Sometime this year, CENTAUR will be spaceborne. Already, the projected uses of CENTAUR bear fascinating implications for the future . . . placing a satellite in an orbit so exacting that it will remain in one spot over the earth's surface . . . soft landings on lunar and planetary bodies . . . timed launchings of several satellites from a single vehicle. Several major guidance functions will be performed in CENTAUR by a compact digital computer system from Librascope. It weighs 62 pounds, occupies little more than ¾ cubic foot. A note to Librascope outlining your control problems will bring a prompt answer from the country's most versatile manufacturer of computer control systems.

GENERAL PRECISION

computer control systems that pace man's expanding mind

LIBRASCOPE DIVISION | GENERAL PRECISION INC., GLENDALE 1, CALIFORNIA

Washington Roundup

Military Space

Statements on the military importance of space continue to come from unexpected quarters. James E. Webb, National Aeronautics and Space Administration chief, told a Minneapolis audience last week that if Soviet Russia should surpass the U. S. in space, "their space technology in its military aspects will jeopardize our security." He said mastery of space by the U. S. is "essential insurance."

Four weeks ago, NASA Associate Administrator Robert C. Seamans, Jr., said the same things in the same words (AW Sept. 4, p. 29). Congressmen and military officers have been emphasizing the military potential of space in recent weeks (see p. 28), but such recognition directly from NASA officials is unusual.

Eisenhower Administration policy required leaders of the civilian space agency to avoid references to military threats in space, partly because the former President objected to the concept of a "race" with Russia and partly for international propaganda reasons.

Question raised by the current NASA comments is whether there is indeed a growing appreciation of the military potential of spaceflight or whether this is a part of the Kennedy Administration's talk-tough policy resulting from the Berlin situation.

GE Satellite Decision

General Electric's abrupt decision to drop its bid for a share in ownership of a commercial communications satellite system (p. 35) resulted primarily from concern of its top officials that efforts made by its subsidiary, Communication Satellites, Inc., had unintentionally strengthened the hands of those who favor government ownership.

GE found itself an unwitting aid in stirring charges of monopoly and big-business domination against American Telephone & Telegraph Co.—accusations that sometimes are levelled at GE itself. Final straw may have been a recent blast by a nationally-syndicated columnist, who sharply criticized the Federal Communications Commission for planning to renew licenses for GE radio and television stations in the wake of anti-trust indictments against the company.

Bidders for the Saturn S-1 fabrication contract were charged $500 each by NASA for the voluminous specifications. This is the first time the agency has charged for anything other than construction specifications. The specifications limit bidders' proposals to 300 pages, and page size and type size are specified. The fees go to the miscellaneous fund of the U. S. Treasury.

Naval Cannonade

Chairman Clarence Cannon of the House appropriations committee, the most powerful budgeteer in Congress, chose the last night of the session to bombard the Navy's aircraft carriers. He said Vice Adm. Hyman Rickover, by developing the nuclear-powered submarine, "has rendered the greatest service to the nation of any man since Lincoln." Then he sighted in on the flattops: "After spending 15 years and billions of dollars preparing the one great weapon to be ready when needed, we now find that all the time and money and emphasis devoted to this huge Frankenstein is utterly wasted and the carriers are useless and will be driven up the nearest river as far as they can go as soon as war is declared or fighting starts. It is the most colossal national debacle in all military history."

Edward C. Welsh, executive secretary of the National Aeronautics and Space Council, will go ahead and try to build a staff in spite of Congress' last-minute rejection of his request for permission to go outside Civil Service regulations on hiring. He may renew the request next year. Congress voted the extra $225,000 he requested for Fiscal 1962 but killed the hiring request on a point of order.

Anti-Jamming Plan

A crash program to counter any Soviet efforts to jam existing navigation aids in the air corridors to West Berlin is being planned by Military Air Transport Service. Among the moves being considered are installation of doppler navigators and use of lightweight inertial navigation systems aboard MATS aircraft and commercial airliners operating under the Civilian Reserve Aircraft Fleet (CRAF) program.

NASA Administrator James E. Webb has rejected an idea—strongly supported by U. S. Information Agency Director Edward R. Murrow—for using the first manned orbital Mercury flight to produce the first simultaneous world-wide television broadcast. Transistorized videcon cameras, already tested in rocket flights, would broadcast to aircraft, which would relay the images around the globe, scoring a major propaganda beat on Soviet Russia.

When NASA's recent attempt to put the Ranger I into an elliptical orbit carrying it deep into space fell far short of the goal, a question arose on whether to call it an Explorer (for earth satellite) or a Pioneer (for probe). A project engineer suggested a compromise: Explainer I.

—Washington Staff

Centaur Acceleration Planned by NASA

Delays in development already have caused a shift of mission; five key programs dependent on vehicle.

By Evert Clark

Washington—Attempt will be made this week to accelerate the lagging development of the Atlas-Centaur space vehicle—the only booster that will be available to the U.S. for major deep space missions for at least 18 months.

Atlas-Centaur is a particularly critical vehicle in the nation's space program. Its use of liquid hydrogen fuel in the Centaur second stage is expected to give the U. S. the first booster capable of lifting payloads comparable to those that Soviet Russia already has put into orbit or sent into deep space. It also was to be the major step between currently available boosters and the 1.5-million lb. thrust Saturn, which will not carry payloads until 1963.

Development troubles that have delayed the Centaur over the past year have come at a time when almost every booster or proposed booster in the U. S. program is under some kind of review. Initiation of all new developments is being postponed until the joint military-civilian Golovin committee (AW Sept. 4, p. 35) concludes its current survey of the propulsion picture.

Five key space programs are tied to the Atlas-Centaur vehicle. A portion of one—an attempt to send two probes to the planet Venus—already has been affected by the development delays (see box). The programs are the Advent military communications satellite, the Mariner A lunar landing and Venus probes, the Mariner B Mars probes, the military-civilian S-3 energetic particles satellite and the Surveyor lunar soft landing vehicles.

A Centaur status review meeting is being held Oct. 2 at National Aeronautics and Space Administration's Marshall Space Flight Center in Huntsville, Ala., with the primary contractors—General Dynamics for the Atlas booster and Centaur stage, and Pratt & Whitney for the 15,000-lb. thrust LR-115 engine, two of which power the Centaur stage.

An attempt will be made to work out a new timetable that may produce the first pre-flight readiness test of the LR-115 engines this month and first flight test of a vehicle in January. There is even some possibility that a flight test could come this year.

First flight originally was scheduled for last July. This later slipped to November and then to next February. Most of the development delay has been due to the engine, but there also have been problems with the Centaur.

Most of the development problems now are considered solved or close to solution, even though a number of questions—storage of the liquid hydrogen in space during long planetary flights—will not be answered until a number of the vehicles have been flown.

Among the problems encountered in the Centaur work were failure to get simultaneous ignition of both barrels of the propulsion package; pumping of the hydrogen fuel; and heat transfer in the engine package and from the hydrogen tanks. Some of the problems were those common to development of any new rocket engine and stage; some were peculiar to the first attempt to utilize liquid hydrogen; some were the result of attempts to simulate the vacuum of space in ground facilities; and some undoubtedly stemmed from the fact that this was Pratt & Whitney's first rocket engine project.

Several months ago, Pratt & Whitney took steps to strengthen the management of the Centaur engine work by moving Willard L. Gorton, assistant engineering manager, to the Florida Research and Development Center as general manager (AW July 3, p. 33). It recently has shifted a sizable number of employes from the main plant in E. Hartford, Conn., to the Florida facility, where development, test and production have been centered. It also has begun to manufacture some LR-115 components in E. Hartford.

Acceleration of the program might lead to production of engines both in Florida and in E. Hartford.

Whether the current review of the Centaur effort will result in less ambitious payload goals than originally planned is not known. NASA has said in the past that Centaur would put 8,500 lb. into a 300-mi. orbit; send 2,300 lb. on escape missions; 1,300 lb. to Mars or Venus; and put 1,250 lb. into a 22,300-mi. synchronous orbit.

A quick look at the booster picture explains why the Centaur program cannot easily be canceled. Atlas-Agena B, which is being used in the Discoverer, Midas and Samos programs, can put 5,000 lb. into a 300-mi. orbit or 750 lb. into an escape trajectory. These weights are far below those planned for Centaur, and no space booster with more payload capacity is due to be ready in less than 18 months.

Even if Centaur is accelerated and meets its payload goals, a problem remains with the Advent satellite. Centaur was supposed to put Advent into a 22,300-mi. orbit. But Advent's weight has continued to grow and is now reported to be more than 2,000 lb.—well in excess of the 1,250-lb. figure mentioned for Centaur. Defense Department and NASA recently considered trying to shave 1,000 lb. from the vehicle itself to offset the growth in Advent's weight.

Use of the Martin Titan II topped by a high-energy upper stage such as the proposed Chariot or Draco (see p. 23) or the Centaur stage, has been proposed to handle the Advent mission.

Mariner Payloads Shifted From Centaur

Washington—Weight of two Mariner A payloads will be reduced to 450 lb. so they can be launched by an Atlas Agena B vehicle on a Venus probe mission when the earth and Venus are in their most favorable relative positions next August and September. If the probes are not launched on schedule, U. S. must wait until March, 1964, for the next opportunity.

The move is being taken because of the difficulties experienced in development of the Atlas-Centaur, originally scheduled to launch the Mariner A. There are five Mariner A vehicles in the program, three of which will weigh the full 1,100 lb.

Transfer of the two Mariner As from the Atlas-Centaur program leaves the program with 23 flights and the following schedule:

- **Calendar 1962: five vehicle development flights, the first containing an Advent communications satellite capsule, two carrying performance instruments, and the fourth and fifth carrying joint Advanced Research Projects Agency-National Aeronautics and Space Administration energetic particles satellites.**
- **Calendar 1963: six launches, one with an ARPA-NASA energetic particles satellite, two with Advent satellites, and three with Surveyor soft lunar landing probes.**
- **Calendar 1964: seven NASA missions, plus delivery of five vehicles to USAF for Advent launches. NASA missions are a Mariner A to the moon, two Mariner A vehicles to Venus, two lunar Surveyors and two Mariner B vehicles to Mars.**

Michoud Manager Named

Washington—George N. Constan has been named acting resident manager of the National Aeronautics and Space Administration's Saturn fabrication facility in Michoud, La., and will be in charge of reactivating the plant.

Constan's appointment was made at a conference for prospective bidders for the Saturn project held last week in New Orleans (AW Sept. 18, p. 26). Twenty-five of the 36 prospective prime contractors invited, attended, along with 33 potential subcontractors. Bids for Saturn S-1 stage are due Oct. 16. NASA hopes to hold prospective bidders conference on S-1B stage before that time.

But Titan II has not yet had its first flight test and Air Force has not yet asked for bids on a high-energy upper stage, even though it has $15 million in Fiscal 1962 funds to begin work.

Nothing further is expected to be done in interim boosters or on several versions of the Saturn and Nova superboosters until the Golovin committee reports—probably in the next two weeks.

Because of the Centaur delays, the Advent weight problem and the question of what boosters shall be used for the orbital version of the Dyna-Soar boost glider and its proposed follow-on weapon system, many industry observers felt that decisions were needed now rather than another committee study, particularly since a committee headed by Dr. Oswald F. Schuette of Defense Department's research and engineering office had just gone over much of the same ground. Others felt that there were so many proposals on the table for interim and large military and civilian space boosters that some comprehensive joint survey was necessary.

Among the proposals:

- **Titan II** plus Centaur or a fluorine-hydrogen stage or the Rocketdyne Nomad high-energy upper stage, and with or without large solid rockets clustered around the first stage.
- **Atlas** topped by an S-IVH stage, which would use a 60,000-lb. Rocketdyne Atlas sustainer engine, converted to burn liquid hydrogen.
- **Thor-Diana,** using the Douglas Thor booster plus a Diana stage powered by one LR-115 engine. Two solid rockets from the Little Joe booster would assist the Thor at takeoff.
- **Atlas** topped by a four-barrelled version of Centaur.
- **S-IVB stage,** based on the S-IV stage of Saturn but using one 200,000-lb. thrust Rocketdyne J-2 engine instead of six LR-115s.
- **Titan I** with two 110-in. solid propellant rockets strapped to the sides.
- **Cluster** of 100-in. solid motors wrapped around a J-2 engine.

Congress Treated Space, Defense Well But Lagged on Civil Aviation

Washington—Congress this year gave an unprecedented amount of attention and money to peacetime scientific and military programs but postponed until next session the decisions on major civil aviation questions.

With little debate, the Congress which adjourned last week gave President Kennedy practically everything he requested for space and defense, thereby committing the nation to spending some $20 billion on the moon program alone between now and the time a U. S. lunar landing is made.

Ease with which the President's space and military proposals sailed through Congress was attributable largely to the "gun-at-the-head" atmosphere which prevailed on Capitol Hill through much of the first session. The Russians did the most to create this atmosphere, but President Kennedy built on it in presenting his space and military programs to Congress.

Gagarin Was Spur

The vision of Maj. Yuri Gagarin orbiting the earth, for example, was fresh in the minds of the lawmakers when President Kennedy, May 25, called for more money to accelerate our own space program. The President rejected the conservative viewpoint that the U. S. was not in a space race. He said: "Now is the time to take longer strides—time for a great American enterprise—time for this nation to take a clearly leading role in space achievements which, in many ways, may hold the key to our future on earth. . . ." (AW May 29, p. 25).

Congress responded by appropriating $1,671,750,000 for the National Aeronautics and Space Administration for Fiscal 1962—$562 million more than President Eisenhower requested and $112 million less than the $1,784,300,000 President Kennedy sought.

For defense, Congress appropriated $46,662,556,000, with $207.6 million going for the civil defense program President Kennedy placed under the Defense Department. This amount is nearly $5 billion more than the $41.84 billion President Eisenhower requested for the military functions of the Defense Department for Fiscal 1962, and a new peacetime high (AW Jan. 23, 1961).

Now the senators and representatives are home trying to determine if the crisis atmosphere which prevailed on Capitol Hill also is felt by their constituents. Already, there are signs that several lawmakers in both parties are having second thoughts about spending billions to reach the moon.

One such indication came at the pre-adjournment press conference of Senate Minority Leader Everett M. Dirksen (R.-Ill.) and House Minority Leader Charles A. Halleck (R.-Ind.). Sen. Dirksen said the moon effort, compared with other scientific endeavors, had "doubtful value" while Rep. Halleck said he had "serious misgivings" about spending so much money on the moon program. Chairman Clarence Cannon (D.-Mo.) of the House appropriations committee also shares this view.

Opposition Stiffened

Such reservations—especially if they are reinforced by attitudes back home—mean tougher sledding for space requests next year, especially in the House which in the closing days of Congress stiffened its opposition to spending programs.

Defense money requests, however, should remain fairly immune from this type of opposition, especially since 1962 is an election year and few would dare vote against U. S. security. A significant example came this year in the Senate when Sen. William Proxmire (D.-Wis.) offered an amendment to strike from the defense appropriation bill the $525 million for bombers Secretary of Defense Robert S. McNamara said he did not need or want. Only three senators joined Sen. Proxmire in voting for the amendment (AW, Aug. 14, p. 30).

Congress this year did demand that the Defense Department obtain more flexibility in its budgeting so programs could be tailored to meet the changing conditions of the cold war. Also, Congress demanded a war on waste by the military. McNamara promised "an attack on all fronts," unveiled a new budgeting program designed to disclose the total cost of a weapon at the outset of its development and to make weapons, rather than services, compete against each other for money (AW, July 31, p. 24). The first test of this new system will come next year when Congress reviews the defense budget.

Ready Answer

McNamara also had an answer to congressional criticism of the Defense Department's use of nonprofit research firms: Budget Bureau will study the whole question and report its finding to President Kennedy by Dec. 1. The House Science and Astronautics Committee staff studied nonprofit firms this year, but what will come of the inquiry depends on the new chairman, Rep. George P. Miller (D.-Calif.), who succeeds the late Rep. Overton Brooks (D.-La.) (see p. 30).

As for civil aviation legislation, it suffered in Congress both from failing to have the same type of urgency as space and defense bills and from House resistance to backdoor spending.

President Kennedy submitted to Congress a five-year, $375-million program of federal aid to airports. His bill would authorize the Federal Aviation Agency to enter into long-term contracts with cities planning airports. This would assure cities that federal money would be forthcoming whether Congress appropriated it or not. The House rebelled at this, putting the program on a year-by-year basis.

Senate backers of the contract authority hoped to salvage at least three years advance funding. Again the House resisted, and last week, just before adjournment, it appropriated $150 million for two years. The Senate backers either had to accept this or nothing, so they regretfully went along with the measure.

Supplementals Bill Stalled

Civil Aeronautics Board got little from this Congress other than the right to carry out the agency's reorganization plan. Differing bills to spell out the rights of supplemental air carriers were passed by the Senate and House, but the conference to resolve differences was postponed until next year (AW, Sept. 18, p. 45).

The next session, because of decisions postponed by Congress this year, promises to be a crucial one for civilian aviation. For one thing, President Kennedy is expected to recommend several legislative actions to improve the nation's over-all transportation system. Secretary of Commerce Luther Hodges has said he will file his recommendations with the President no later than Nov. 1.

Another important development will be the staff study and Senate aviation subcommittee hearings on international air traffic agreements. The subcommittee laid the groundwork for these hearings just before Congress adjourned.

Also put off until next year are the proposals to tax jet fuel and to raise air mail rates.

USAF Aims at Military Space Supremacy

By George Alexander

Philadelphia—Air Force, increasingly concerned with the military threat posed by a rapidly-developing Soviet space capability, made clear its goal of U. S. military superiority in space at a symposium held during the recent Air Force Assn. meeting here.

Concern of industry and government with the military significance of space was evident, as Air Force pressed for a unified national space effort and removal of the space exploration restrictions imposed on the military services at the time of the National Aeronautics and Space Administration's creation.

Trevor Gardner, former USAF assistant secretary for research and now president of Hycon Manufacturing Co., was chairman of a panel which included Gen. Bernard A. Schriever, commander of Air Force Systems Command (AFSC), Rep. Emilio Daddario (D.-Conn.), Dr. Edward C. Welsh, executive secretary of the National Aeronautics and Space Council and Dr. Walter R. Dornberger, vice president of Bell Aerosystems Co.

All five panel members stressed the military implications of the Vostoks and Sputniks and warned that Soviet control of space, if accomplished, threatened the nation's survival and not just the freedom of the U. S. to explore space.

Dr. Welsh said that "the Communists have expressed their determination to dominate the world. . . . and you can be sure that they are not spending such effort and resources unless they believe firmly that it can be justified in terms of world domination." Gardner described the Soviet space threat as "imminent and dangerous" and called upon the Kennedy Administration to match the commitment for a lunar landing program with a similar pledge for a strong and effective U. S. military posture in space.

Welsh cited the 1958 Space Act, which created NASA and established as U. S. policy that "activities in space should be devoted to peaceful purposes for the benefit of all mankind." He said that while this policy was sound, it is sometimes misinterpreted to mean that space has no military applications. This is not true, he said.

"In my view," the Space Council secretary said, "we do not have a division between peaceful and non-peaceful objectives for space. Rather, we have space missions to help keep the peace and space missions to help increase our ability to live well in peace."

Welsh said that the 1958 Space Act did recognize the military uses of space by exempting from NASA control those space activities which are related to national defense, these being the proper concern of the Defense Department. In addition, Welsh pointed out, the act required an exchange of information on space activities between Defense and NASA, adding: "If only one agency were expected to be fully responsible for space programs, there would be no occasion for that provision."

Defense Department responsibility in space was not clearly spelled out in the original draft of the act written by the Eisenhower Administration, Welsh said, but Congress "saw the error and changed the language."

Welsh, apparently referring to Air Force and NASA programs, said "it is more important to cure duplications of omission than duplications of performance. In the latter, the job gets done even though it may be done wastefully, while in the former, the job doesn't get done at all."

Welsh said that the advantages of manned space vehicles—the ability of an astronaut to make observations and decisions—are obvious and are "equally applicable, whether the spacecraft is on a mission to maintain the peace or on a mission limited to increasing our scientific knowledge."

Welsh answered those critics of space who contend that the money spent on these programs could be better applied to cancer research by saying: "If we don't start spending more on defense [in space], we won't be around long enough to get cancer."

The military services, barred from conducting open-end research in space by the Space Act and the Eisenhower Administration's dictum that space is for peaceful purposes, have been authorized to explore space only in support of such sharply-defined missions as reconnaissance, navigation, communications and satellite interception.

Gen. Schriever, in stating USAF's case for a freer hand in conducting space research, said: "The key to rapid utilization of space by man for military and civilian purposes is flexibility. We must not design our space vehicles and programs just to achieve those objectives which we can define now. We must design the vehicles with enough capacity to rapidly adapt to, or incorporate, the vast new knowledge which will flow from our space program. A manned space observatory should be designed so that the composition of the crew of observers can be modified or completely changed to accomplish new or additional missions."

The AFSC commander said that the best approach to a military space program is a mixture of unmanned and manned space vehicles and that a greater emphasis on the latter is required. Schriever listed the following as essential for the development of a military capability in the realm of space:

- **Large boosters** able to place heavy payloads in space.
- **Maneuverability** of spacecraft, with appropriate navigation.
- **Re-entry and landing** techniques to allow a vehicle to return to earth at any point.
- **Rendezvous,** to effect refueling, cargo transfer and anything else required to support man in space.
- **Identification and interception** of hostile satellites.

Schriever said that the U. S. has "historically tended to overestimate what we could do on a short-term basis and to grossly underestimate what we could do on a long-term basis." Consequently slow to grasp the military importance of new inventions, the U. S. in the past had the oceans to buy time for war preparation. "But today," he said, "technological surprise could be fatal. We should recognize that there is no inherent difference between basic military and non-military space technology. The same techniques that can send a man into space as a scientific observer may also send him in a military role."

Gen. Schriever, when asked about the future role of the Air Force in space, replied: "I'll have a better answer to that [question] in 90 to 120 days from now." Observers understood him to mean that he is waiting for the various NASA-Defense Department committees to file their reports, to see whether USAF has made its point of the necessity for a unified space effort.

An indication of some Congressional support for USAF's effort was Rep. Daddario's remark: "The development of outer space is a national goal. The civilian and military must work side by side in this space effort . . let us remember that when our big boosters roar upward at Cape Canaveral, the words lettered on them will not read 'NASA' or 'Department of Defense' but simply 'United States.'"

Questioned about the possibility that NASA's new Manned Space Flight Laboratory at Houston, Tex. (AW Sept. 25, p. 350), might duplicate existent facilities, Rep. Daddario said that he would support the laboratory only if it complemented the nation's present bioastronautics capability.

Dr. Dornberger said that the Soviets undoubtedly recognize space as "an opportunity for obtaining a new and unique military superiority" and reiterated his prediction (AW Sept. 18, p. 57) that, if they do achieve control of this new medium, one of their first actions probably will be to eliminate "our space systems, such as reconnaissance, weather, communication, navigation, detection and interception satellites." At present, Dr. Dornberger said, there would be little the U. S. could do about it.

Beech Will Market Pressurized Twin With Turboprop Powerplants

Tulsa, Okla.—Firm commitment to develop and produce a twin-turboprop six-to-eight-place business plane, with deliveries of certificated airplanes anticipated during 1964, was made here by Beech Aircraft Corp. Vice President-Domestic Sales Leddy Greever during National Business Aircraft Assn.'s 14th annual forum.

The airplane that Beech will build, according to Greever, will have a cruise speed of 300 mph. and nonstop range of over 1,500 mi. with allowances for warmup, taxi, takeoff, climb to altitude and "adequate fuel reserve."

The all-metal, low-wing, tricycle-geared airplane will have a pressurized cabin.

Greever declined to go beyond these broad parameters in his disclosure of the new project, stating that complete specifications and a full-scale mockup will be unveiled within the next 90 days.

Price Estimated

He also stated that a basic airplane, with interior and fitted for Instrument Flight Rules operation, but minus optional equipment and electronics, would cost less than $400,000.

Although Beech has been known to have been conducting studies in the turbine field for some six years and to have spent approximately $8 million thus far on thousands of experimental and engineering man-hours on varied projects, indications are that management's decision to go ahead on the new airplane was made only a few days before the meeting started and caught many people within the company, as well as industry observers, by complete surprise.

It is believed that the reason Beech was unable to provide more information than it did here last week was that beyond preliminary engineering covering a wide variety of possible configurations some major decisions, including final choice of powerplants, have yet to be made. Right after the announcement here, the company was besieged with calls from its distributor-dealer organization asking for information and representatives here were trying to round up copies of Greever's statement to determine what could be said.

Foreign Engines Likely

Although Beech would not even discuss powerplant choices, indications are that the Turbomeca Bastan and Astazou are leading contenders for the initial airplane, although the Canadian Pratt & Whitney PT6 turboprop could not be discounted. There also is reason to believe that the company may make several versions available with a choice of powerplants so that the customer could buy one or the other, depending upon how much money he was willing to spend.

Manufacturers' Comment

Engine manufacturers maintain that they are completely in the dark as to Beech plans and that beyond having supplied the normal engineering and cost data on their engines, they have no clues as to what the airframe manufacturer is contemplating in the way of installations.

This would tend to bear out feelings that Beech itself has not yet made any firm decision in this area.

The company has conducted extensive wind tunnel programs to study flap and fillet development, nacelle size and placement, as well as developing experimental new types of wing construction and wing sections. Some of these have been built and static tested, as well as differing fuselage sections, to determine proper size and configuration.

Tests have also been made on a variety of heating, air conditioning and pressurization system combinations to reduce complexity and weight penalties as well as develop optimum passenger comfort features.

Market studies thus far have included discussions with more than 50% of all U. S. corporate fleet operators in the Beech Twin-Bonanza, Queen Air and Model 18 class or larger. These indicated that most corporate flight operations were conducted over stage lengths of less than 500 mi.

Details Guarded

Although the company is tightly guarding further details regarding the new twin-turboprop, some of the parameters disclosed would indicate an airplane in the Queen Air class and it is known that Beech has conducted detailed studies on turboprop versions of this airplane. In fact, the price bracket disclosed by Greever would fall well into just this type of project, since sources close to the company's investigations have estimated that pressurizing and "turbinizing" the Queen Air would more than double the price of the standard piston-powered model of the airplane.

If such is the case, then this basic airframe would undergo major modification, including an entirely new, low-drag wing, probably incorporating some laminar flow and a new tail of lower-drag characteristics, as well as general clean-up of the fuselage.

Miller Opposes Stress on Race to Moon

By George C. Wilson

Washington—Rep. George Paul Miller (D.-Calif.), newly elected chairman of the House Science and Astronautics Committee, firmly believes the U. S. space effort should be a step-by-step program rather than a headlong race to the moon.

"The path to the moon is not a racetrack," Rep. Miller told Aviation Week. "We are following a definite plan with fixed, scientific objectives and we're right on schedule. This doesn't mean you have to pull your punches on the moon. Sure, it would be nice to beat Russia there. But what we're really after is knowledge and information which will add up to a steady advance into space.

"I don't like to think we're behind in space," he said. "I think we're accumulating more scientific data and disseminating more of it than the Russians are. This over-emphasis on a race is all wrong."

This conviction that the U. S. should proceed to the moon at its own pace is shared by the conservative bloc in the scientific community and by many other members of Congress.

The effect of Rep. Miller's views on the House space committee will be felt between now and next January when Congress reconvenes. Changes in prospect—some obvious, others subtle—will, among other things, reshape the relationship between Congress and the aerospace industry.

Obvious changes include formation of hard-hitting subcommittees staffed with experts in various space fields; a switch in committee emphasis from broad, general topics like this year's hearings on defense research to narrower topics like management of the life sciences program; and frequent field trips by the committee and its staff to government and industry space installations.

Under the chairmanship of the late Rep. Overton Brooks (D.-La.), the emphasis was on full committee hearings, usually attended by only a fraction of the 25 members. Present membership is 27. The questioning was seldom done by staff people steeped in the subject at hand. Consequently, the hearings often took a rambling, shallow course.

Even so, Rep. Brooks focused attention on a number of space subjects which would not otherwise have been discussed. His hearings, despite shortcomings, did help educate Congress and the public on space matters and helped create what Rep. Brooks called "a sense of urgency."

Reorganization Planned

But this approach is due for a change. "The necessity for long posture hearings is past," Rep. Miller told Aviation Week. He plans to reorganize the committee so that the subcommittees will ride herd on specific agencies with space responsibilities such as the Defense Department, National Aeronautics and Space Administration, National Bureau of Standards, National Science Foundation and the Weather Bureau (AW Sept. 25, p. 350).

Subtle changes in prospect will include more committee flexibility internally and a more critical attitude externally. These two changes are related.

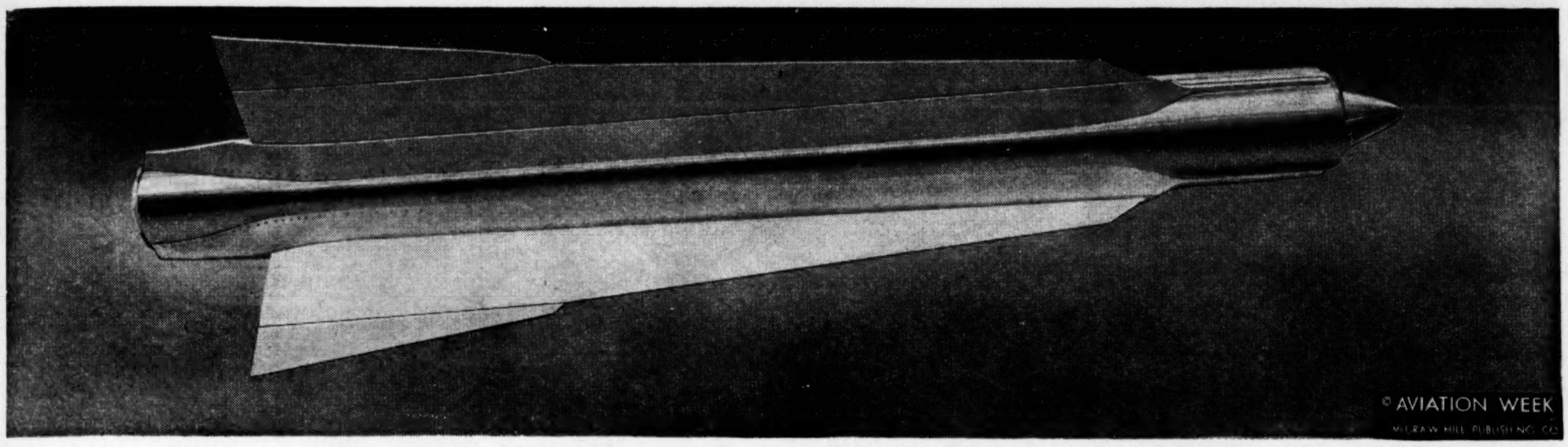
Chairman Miller does not intend to make the committee a one-man show. This attitude in itself will give the committee a new flexibility. Staff experts will have more authority to block out the territory for committee hearings; more opportunity to ask questions once the hearings are under way, and more chance after the hearings to write reports provocative enough to inspire debate on the policy questions arising with increasing frequency as the U. S. plunges deeper into space.

Challenge to Firms

One result will be a stiffer challenge to aerospace companies. They will find subcommittees and their staffs visiting their plants, will have to do more homework before hearings, and will find themselves criticized more penetratingly in staff reports. At the same time, the committee's increased technical competence promises a better opportunity for the aerospace industry to gain the understanding of lawmakers.

Rep. Barratt O'Hara (D.-Ill.), one of Rep. Miller's closest associates in Congress, told Aviation Week: "George Miller, even though he kids a lot, is one of the ablest and most respected members of the House." As for Rep. Miller's age—70—Rep. O'Hara said: "When they started hitting him on that back in the [Rep. Miller's congressional] district, he climbed into a jet plane and flew faster than sound. And, he's also

REP. GEORGE P. MILLER (D.-Calif.), new chairman of the House Science and Astronautics Committee, enters the White House for a recent visit with the President. Rep. Miller succeeds the late Rep. Overton Brooks (D.-La.).


© AVIATION WEEK
McGRAW-HILL PUBLISHING CO.

Typhon Missile to Enter Fleet Service in 1966

Unusual aerodynamic configuration of Navy's Typhon surface-to-air missile system under development by Bendix Corp. features very low aspect ratio wings with all-movable tip control surfaces. Airframe and ramjet engine development is assigned to McDonnell Aircraft Corp. Westinghouse Electric Corp. is developing weapon direction equipment. Range is estimated to be 200 mi., and peak cruise altitude 120,000 ft. Typhon is an outgrowth of the Talos ramjet anti-aircraft missile and will have extended range, improved accuracy, target-handling capacity and quick reaction capability compared with the earlier weapon. Ten targets can be handled simultaneously by 10 individual missiles, fired under the control of a random-pulse radar system. Typhon concepts and preliminary design originated with Applied Physics Laboratory of the Johns Hopkins University. Missile system is expected to enter fleet service in 1966.

one of the most traveled members of the House."

Another Miller colleague, also a member of the House space committee, said the new chairman's own role will make little difference if he goes through with his promise to give subcommittees adequate authority.

"You've got lots of young men on that committee eager to get into space questions," he said. "They're ready to go. So what difference does it make how much time Miller himself gives to hearings as long as he gives subcommittees the authority they need to operate effectively?"

The youthfulness of the House committee is in significant contrast to the Senate Aeronautical and Space Sciences Committee. Most of the House space committee members are still trying to carve out their political niches. Nearly all the Senate space committee members already have made national reputations in other fields and seldom concentrate on space.

Rep. Miller said he is enthusiastic about his new chairmanship. "The mission of the committee," he said, "will be to stimulate interest and thought and to plead the cause of space in the legislative halls."

The present space program "is a good one and in very capable hands," he said. The military's role in space, Rep. Miller said, is big enough and should not be enlarged.

As to Russia's lead in the big booster field, Rep. Miller attributed it to the U. S. decision to concentrate on miniaturizing space payloads. "If a mistake was made," Rep. Miller said, "it was through inculpable ignorance."

Rep. Miller was born in San Francisco Jan. 15, 1891. He holds a civil engineering degree from St. Mary's College in California. The new committee chairman served as a lieutenant in the field artillery during World War I.

Rep. Miller began his political career in 1936 when he was elected to the California State Assembly. In November of 1944, he was elected to the House of Representatives. He has been re-elected ever since, beating his Republican opponent in the last election by 152,476 to 93,403. His Eighth Congressional District encompasses the eastern half of the city of Oakland and Southern Alameda County.

Rep. Miller considers himself a liberal Democrat and was an early supporter of President Kennedy. He is a member of the House Merchant Marine and Fisheries Committee and was chairman of its Oceanography Subcommittee until he resigned Sept. 21 to become chairman of the space committee.

Navy Evaluating Bids For Undersea Robot

Proposals for the fabrication and testing of an underwater search and recovery vehicle applicable to a wide range of operations are being evaluated by the Naval Ordnance Laboratory, Silver Spring, Md. Bids were submitted last month in an industry competition. Delivery of the vehicle is expected by the middle of next year, tests will be conducted at NOL's Ft. Lauderdale, Fla., facility.

Indications are that the undersea vehicle will weigh 1,000-1,500 lb., exclusive of cable and auxiliary equipment, and measure approximately 5 by 5 by 10 ft. It will be required to operate and remain leakproof for a period of 8 hr. at a depth of 2,000 ft., in a current of 0.1 kt. or less. Requirement will be to carry, launch, and recover the vehicle in open sea by a converted landing-craft-type vessel.

Vehicle frame will be designed to rest on or move along the ocean bottom. It will incorporate a high resolution television camera housing and approximately 3,500 ft. of cable, which will be the electrical connection between the vehicle's propulsion system, control instrumentation, TV, and tool manipulation equipment, and the controls on the surface ship.

Approximately 100 lb. of manipulators and tools will be carried. Tools will be relatively small in cross section, and will be clamped rigidly to the vehicle, with working surfaces extending approximately 2 ft. forward of the vehicle within the TV camera's view.

Vehicle will have a slight positive buoyancy, to allow it to rise to the surface in the event of loss. It will operate in open ocean waters in depths up to 2,000 ft., and its propulsion will permit the surface operator to move the vehicle up and down, forward and back, and turn in approximately its own diameter. In operations off the bottom, the vehicle will be able to hover in or move against currents up to 3 kt. at 1,000 ft. depth or move at a 4 kt. horizontal speed in still water at 1,000 ft. At mid-depths or on the bottom, propulsion controls would permit maneuverability to ± 3 in.

Planet Study Grant

Washington—Stanford University School of Medicine has received a $380,640 research grant from the National Aeronautics and Space Administration to design instruments for Venus and Mars probes to determine the evolution of life on those planets.

The project, to be directed by Dr. Joshua Lederberg, is aimed at determining the nucleic structures of microscopic organisms. The grant will support research through March, 1964.

NASA to Use Industry-Trained Managers

By Edward H. Kolcum

Washington—National Aeronautics and Space Administration, faced with a vastly increased manned space flight program and a budget that is expected to reach $3-4 billion annually in a few years, will reorganize Nov. 1, putting increasing reliance on young industry-trained managers and simplified reporting lines.

One man—Dr. Robert C. Seamans, Jr., associate administrator—emerges as the top technical executive in the space program. Ten field stations which formerly reported to three headquarters offices will report directly to him, and all technical programs will be incorporated into four technical offices, also reporting to Seamans.

The Launch Vehicles Office and Life Sciences Office are being abolished, and their programs will be integrated into the specific flight or research programs they support.

New Offices

New technical offices and their directors are: Advanced Research and Technology, Ira H. Abbott, now director of the agency's Advanced Research Programs; Space Sciences, Dr. Homer E. Newell, Jr., deputy director of Space Flight Programs; Manned Space Flight, Brainerd Holmes, general manager of Radio Corp. of America's Major Defense Systems Division; and Applications, expected to be headed by John J. Burke, executive vice president of the Siegler Corp., a holding company for electronics manufacturing firms.

Program directors are responsible for defining technical objectives, defending project and program funds, establishing schedules and evaluating progress.

Thomas F. Dixon, appointed director of the Launch Vehicles Office in August, becomes Dr. Seamans' deputy.

A NASA official said the new organization effectively eliminates the compartmentalization into which the agency was drifting, with centers and project chiefs reporting to individual program offices. Some in the agency fear that Dr. Seamans and Dixon will be spread thin with direct management responsibility for all programs and centers, and that the new organization will evolve into decisions from junior staff members in Seamans' office. However, others, including NASA Administrator James E. Webb, feel the new organization will give greater emphasis to the agency's major programs, which are included in the four program offices.

Elimination of launch vehicles and life sciences as major program offices, NASA said, does not indicate that these programs are being downgraded. Projects in the current programs will be split according to mission. Dixon will be the top management official for all NASA launch vehicles except Saturn and Nova, which have been keyed to the manned space flight program. It is expected that vehicle branches will be established in the four program offices according to mission requirements.

A NASA spokesman said elimination of the controversial Office of Life Sciences is not a surrender to the Air Force or congressional critics of the agency's plans to build a capability in bioastronautics. Although the program is being split, the total number of headquarters bioastronautics professionals will be increased from 11 to 27 during Fiscal 1962.

Criticism of the office began with its establishment in 1959 and has centered around the fear that it duplicates an existing Department of Defense function.

Appointment of Dixon and Holmes, and the possible appointment of Burke represent a significant departure from the early structure of NASA, in which top government scientific officials were made top NASA program managers. Dixon, 46, was chief engineer of Rocketdyne Division of North American Aviation, Inc. The shift to young industrial talent also is apparent in Holmes, 40, and Burke, 38.

Unanswered Questions

The new NASA organization establishes clear-cut assignments for all the agency programs into one of the four new offices, but it leaves unanswered many personnel questions. A number of headquarters people have been involved both in specific programs and advanced technical development, and these two areas are being separated. The agency expects to complete the organization and personnel assignments this month.

In addition to assignment of new program directors, other major personnel changes already made involve Abe Silverstein, who was director of Space Flight Programs, transferred to Lewis Research Center as director, and Robert R. Gilruth, whose appointment as director of the newly authorized Houston Manned Spacecraft Center was made formal (AW Sept. 25, p. 350). Gilruth is presently director of the Space Task Group at Langley Field.

Eugene J. Manganiello, who has been acting director of Lewis since the retirement of the late Edward R. Sharp last year, will resume his permanent job as assistant director.

In the new organization, Abbott's office sheds its former role of institutional support for Langley, Lewis, Ames and Flight Research Centers and becomes a program office for all advanced technical developments, and all aeronautical programs. This involves a major shift from the current Launch Vehicles Office in programs not related to specific flight missions, and will include nuclear and electric propulsion, supporting research in solid fuel and liquid fuel propulsion, space power technology and power supplies.

Also shifting to Abbott's office will be a part of the life sciences work, particularly the advanced life support systems research.

Enough Flexibility

NASA did not follow the suggestions of the Weisner committee or Project Horizon in establishing a separate aeronautical office, because of a philosophy of non-compartmentalizing (AW Sept. 18, p. 25). The agency feels the new organization is flexible enough to conduct additional aeronautical research if an increase is required in military or civil aviation.

Applications Office will include all weather and communications satellite program activity, which has been split from the current Space Flight Office. Also split from Space Flight are Dr. Newell's Space Sciences, and Holmes' Manned Space Flight.

Dr. Newell will be executive director for all unmanned flight programs with the exception of communications and weather satellites. This includes all lunar and planetary programs, and scientific satellites and probes. In this category are Ranger, Surveyor, Prospector, Mariner and Voyager lunar-Venus-Mars missions, and the continuing satellite programs to sample magnetic and radiation characteristics. Geophysical, astronomical and solar observatories are in this office.

Space biology programs to determine existence of extra-terrestrial life will be shifted to the Space Sciences Office.

Office of Manned Space Flight will direct the over-all systems evaluation and engineering for spacecraft, launch vehicles, ground support equipment, and tracking and communications networks. Aerospace medicine will be integrated into this office, and the director of life sciences programs, USAF Brig. Gen. Charles H. Roadman, will become one of the key deputies in the program.

Staff offices and their directors will be: Legislative Affairs, Paul G. Dembling; Plans and Programs Evaluation, Abraham Hyatt; Public Information,

O. B. Lloyd, Jr.; Technical Information and Education, which was transferred from a program to an executive office, Shelby Thompson; General Counsel, John A. Johnson; International Programs, Arnold Frutkin; and Executive Assistant Franklyn Phillips.

Dr. Seamans' staff offices are Programs, directed by D. D. Wyatt, and Administration, directed by Albert F. Siepert; field centers which formerly reported to program directors now report directly to Dr. Seamans and Dixon.

Marshall Space Flight Center, headed by Wernher von Braun, and the NASA Atlantic Missile Range launch operations directorate, headed by Kurt H. Debus, formerly were part of the Launch Vehicles Office.

Formerly under the Space Flight Office were Jet Propulsion Laboratory, directed by Dr. William H. Pickering; Goddard Space Flight Center, headed by Dr. Harry J. Goett; Space Task Group, directed by Gilruth, and Wallops Station, directed by Robert L. Krieger.

Under Advanced Research Programs were Langley Research Center, directed by Floyd L. Thompson; Lewis Research Center; Ames Research Center, directed by Smith J. De France, and Flight Research Center, directed by Paul F. Bikle.

Soviets Claim World Helicopter Records

Moscow—Soviet Union is claiming world speed and lifting records for helicopters. Tass, the Soviet news agency, said a "flying crane turborotor helicopter" lifted a payload of 15,103 kg. (33,302.12 lb.) to 2,200 meters (7,218.2 ft.) to set records for payload and altitude with such payload. Apparently this was the Mil flying crane seen at Tushino (AW July 17, p. 30).

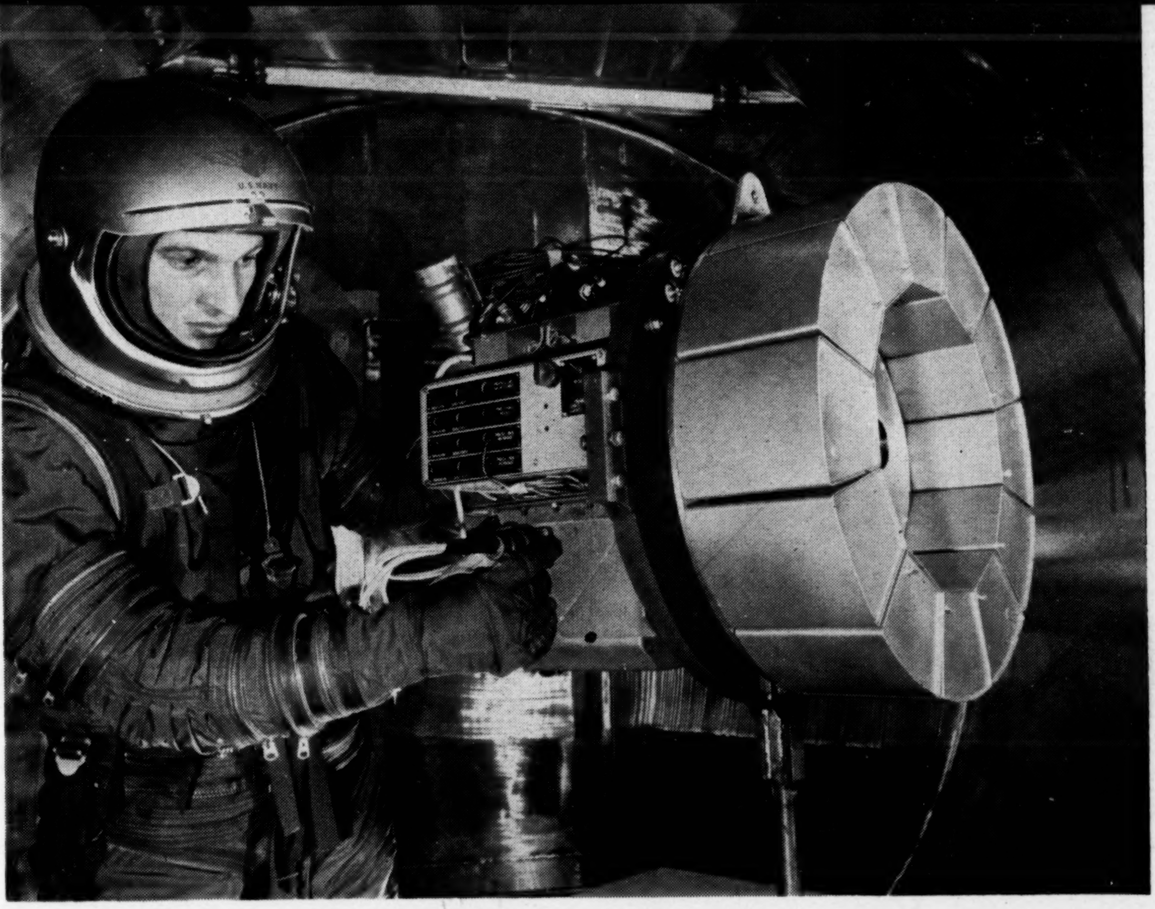
Tass also said the Mil-6 helicopter on Sept. 21 averaged 320 kph. (198.85 mph.) over 15-25 km. (9.3-15.5 mi.).

The previous world record was set in the U.S. when a Navy Sikorsky HSS-2 flew at 192.9 mph., over a 1.86 mi. straight line course (AW May 22, p. 33).

Titan I Is Launched From Operational Silo

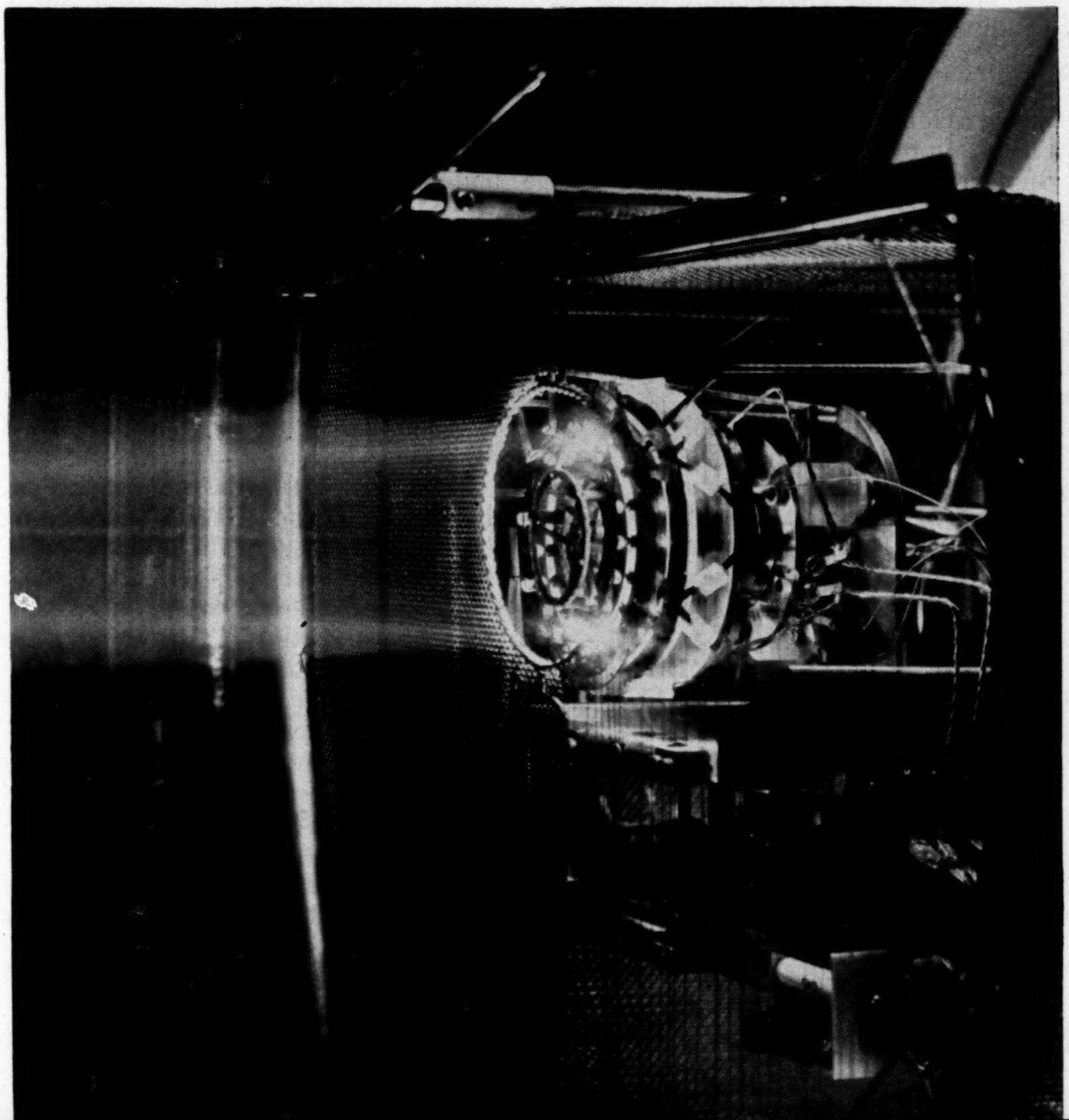
Los Angeles—First launch of a USAF-Martin Titan I intercontinental ballistic missile from an operational-type silo took place on Sept. 23. A dummy warhead carried by the missile landed in the predicted impact area near Wake Island 4,500 mi. from the launching site at Vandenberg AFB.

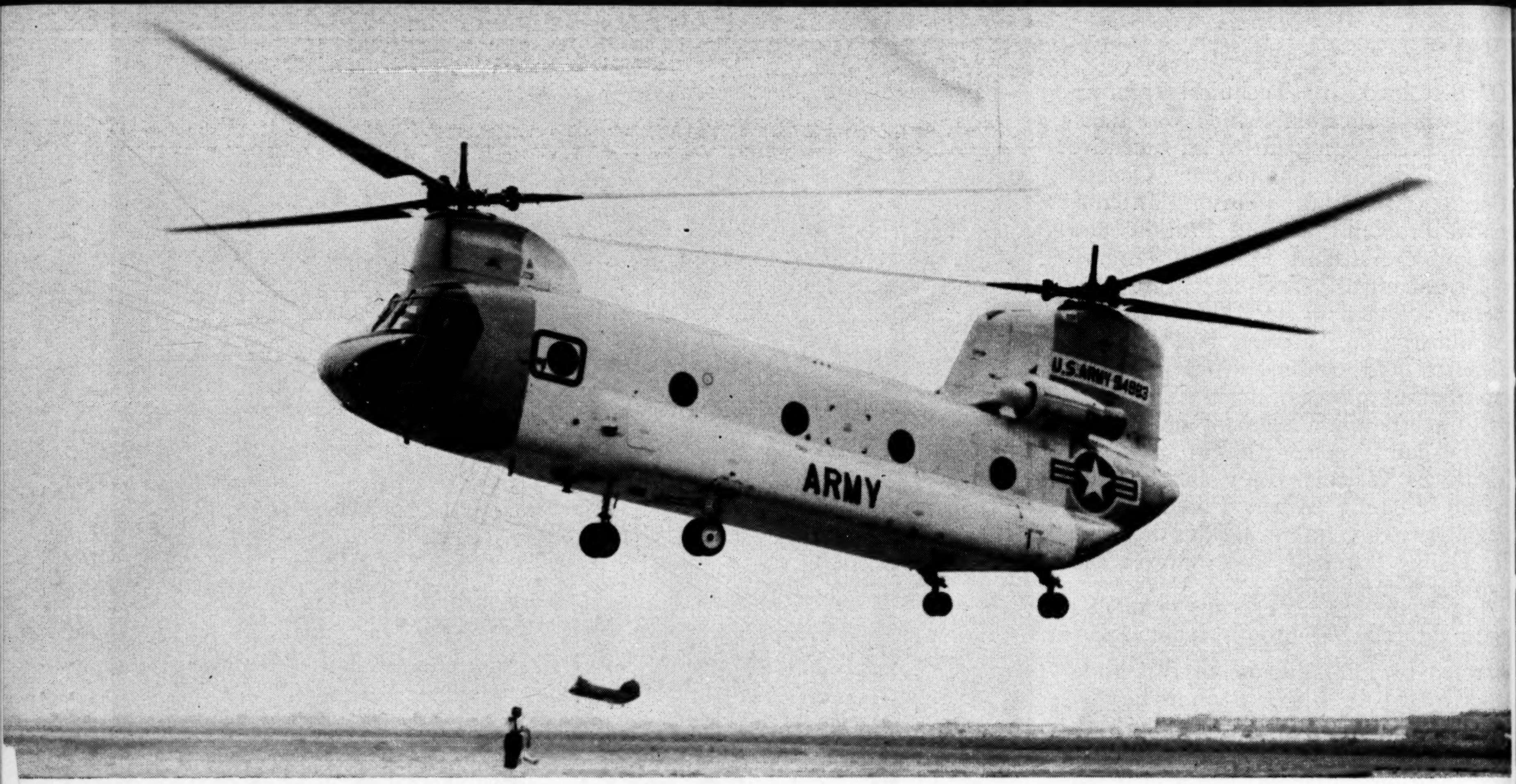
First underground launch of a modified Titan I from within a Titan II silo took place from Vandenberg last May (AW May 8, p. 30.)



Electrical Propulsion Engines Tested

Republic's pulsed pinch plasma electromagnetic engine (above) uses nitrogen as working fluid to produce specific impulses in the range from 1,000 to 7,000 sec. Nitrogen is ionized to plasma, pinched and accelerated by pulsed power, starting as voltage stored in capacitor banks around the engine. Exhaust velocities are on the order of 100,000 mph. Pulsing rate can be as high as 10 cycles per second, which produces an almost continuous thrust. Hughes' electrostatic engine (below) uses cesium as propellant, contact ionized by diffusion of the cesium vapor through hot tungsten. Engine will be flown late next year in the first of a series of 10 Scout-boosted payloads with electrical propulsion systems. Hughes engine has operated a total of 40 hr., continuously up to about four and one-half hours. Specific impulse is 8,700 sec. with 10,000 volts accelerating potential. Thrust developed is on the order of two millipounds (0.002 lb.) at efficiency of about 62%.





Boeing-Vertol HC-1B Completes First Hover Tests

Army/Boeing-Vertol HC-1B Chinook helicopter has completed first hover phase of its flight test program. The twin-turbine helicopter weighed 12½ tons during the hover test. The HC-1B is being developed by USAF Aeronautical Systems Division for the Army.

Dr. Charles Herzfeld Appointed As Project Defender Coordinator

Washington – Advanced Research Projects Agency has named Dr. Charles M. Herzfeld as coordinator of its expanding Project Defender program—the Defense Department's advanced research effort for ballistic missile defense. Herzfeld, a 35-year-old physicist, comes from the National Bureau of Standards where he was an associate director.

Herzfeld also will direct personally two of the four major technical areas under Defender. The remaining two will be under Albert M. Rubenstein, who previously directed the entire program.

The move reflects the growing number of Project Defender programs which require Defense Department direction. Defender is the largest program in ARPA, funded for $104 million in current fiscal year which represents about 55% of the agency's total budget.

Data on ballistic missile re-entry obtained to date under Project Defender has been used to enhance the ability of Nike Zeus radars to discriminate between ICBM warheads and other types of re-entry objects. ARPA has been asked to submit its views on the technical effectiveness of Nike Zeus for use by Defense Department in deciding whether to recommend initial production of the anti-ICBM missile system for Fiscal 1963.

The Project Defender program currently encompasses these four major technical areas:

- **Research**, to increase basic knowledge of the atmosphere and ionosphere. For example, ARPA is sponsoring the radar with 1,000-ft.-dia. antenna now under construction in Puerto Rico, which will be used to measure electron density.
- **Missile phenomenology**, a term applied to the obtaining of data on the behavior of ICBMs at launch and their warheads during re-entry by measuring their electromagnetic radiation over a wide portion of the spectrum at various altitudes. Initial measurements were made by a specially instrumented ship, the USS Mariner, but far more extensive facilities are now under construction on RoiNamur Island, near Kwajalein, in the Pacific (AW Apr. 17, p. 69). ARPA also has a small site for making such measurements at the National Aeronautics and Space Administration's Wallops Island facility.

More than half of the Project Defender funds are allocated for the missile phenomenology portion of the program, which involves costly facilities.

- **Components and techniques**, such as advanced radars, antennas and other devices especially suited for ICBM defense, which are not being developed for other uses by other agencies. Typical of this effort is the electronically steerable array radar (ESAR) developed by Bendix Corp. ARPA also is funding advanced work in optical masers (lasers) and plans to increase its programs in this field.
- **Systems**, intended to explore the feasibility of more promising ICBM defense concepts and to provide guidance on what new components and techniques are needed. Two such programs now under way include ballistic missile boost intercept, known as Bambi, and ARPA terminal defense, known as Arpat. The former includes study contracts with Convair, Space Technology Laboratories and Hughes Aircraft (AW Apr. 24, p. 23; May 1, p. 23). The Arpat study prime contractor is Raytheon, with Hughes, Boeing and International Business Machines Corp. as subcontractors (AW July 3, p. 29.). Lincoln Laboratory also will play a major role in evaluating radar techniques.

The research and missile phenomenology portions of the Project Defender program are under the direction of Herzfeld, while the components and techniques and systems portions are under Rubenstein. Herzfeld's new title is Assistant Director for Ballistic Missile Defense Research.

Officials at ARPA believe the agency has sufficient funds to support worthwhile investigations in the ICBM defense field and that no new feasible approaches are likely to appear until more information is available on the nature of the threat and its environment.

GE Drops Satellite Bid

Washington – General Electric has withdrawn from contention for part ownership in a commercial communication satellite system, leaving the field to existing communication common carriers.

GE Vice President Dr. George L. Haller, in a letter last week to Federal Communications Commission Chairman Newton Minow, said that the company was dissolving its Communication Satellites, Inc., formed earlier this year as a nucleus for ownership and operation of a commercial communication satellite system, and withdrawing its request for FCC licensing. Haller, who heads GE's Defense Electronics Division, was chairman of the board of Communication Satellites, Inc.

Haller said the company fully supports "the President's decision to encourage the establishment of a privately owned communication satellite system as quickly as possible in a manner consistent with the public interest. It is urgent that this be done so that the U. S. will not be pre-empted by the Soviet Union from the critical opportunity to be first."

The letter said GE had reviewed its position recently in the light of the increased national space program and had decided not to divert its resources into the carrier communications field, but to concentrate on its traditional role as a manufacturer of space vehicles and related equipment.

Communication Treaty Is Ratified by Senate

Washington—Senate last week unanimously ratified a telecommunications treaty allocating radio frequencies world-wide for space research, radio astronomy, air navigation and radiolocation.

The action came after Defense Department unexpectedly—and apparently at White House direction—capitulated on the eve of congressional adjournment and agreed to give airlines permanent access to the 8,800-mc. band for their doppler air navigation system.

Air Transport Assn. and Aeronautical Radio, Inc., had successfully blocked ratification as a strategy to force this action (AW Sept. 11 p. 36). ATA estimated the planned airline investment in doppler installations—which would be useless without access to the 8,800-mc. band—at over $10 million.

Previously, airlines were permitted only "temporary" access to the band, used by Defense for air defense and target radiolocation.

The White House was notably concerned over the implications to the space program and U. S. leadership in the telecommunications field of the failure to ratify the treaty drawn in December, 1959, by the International Telecommunications Union.

U. S. is now initiating negotiations aimed at obtaining frequency allocations for operational space systems—meteorological and communications—at the 1963 conference of ITU. It would be on a poor footing to present its case to the overwhelming majority of countries more interested in allocations for political broadcasting if the space research allocations already available had not been approved.

Until the treaty was ratified last week, National Aeronautics and Space Administration was also saddled with months of red tape in negotiating bilaterally with other nations for frequencies for space research projects.

The Defense decision opening the way for ratification was channeled through the agencies responsible for implementing it in hours: from Defense to Interdepartment Radio Advisory Committee, to Federal Communications Commission, to Sen. William Fulbright (D.-Ark.) chairman of the Senate Foreign Relations Committee.

ADC Grounds F-106s After Trio of Crashes

Convair F-106 Delta Daggers have been grounded by the USAF Air Defense Command as a precautionary measure following three crashes, one of them fatal. ADC said the order applies to training and transition flying and does not affect the emergency capability of units operating the aircraft. Presumably, these units would scramble if the order were given but will not engage in practice alerts until the grounding order is rescinded.

The exact cause of the accidents has not been determined at this time, ADC said, adding that precautionary grounding is a standard procedure in the case of a series of unexplained crashes. The three accidents which precipitated the grounding occurred at Minot AFB, N. D., Kincheloe AFB, Mich., and at Geiger Field, Spokane, Wash.

No definite cause has been found for the accidents nor does there seem to be any trend to them. The fatal crash at Spokane occurred while an F-106 was on final approach for landing. The aircraft suddenly dived into the ground from what appeared to be a normal approach.

The grounding order applies to all models of the Delta Dagger and will remain in effect until factors causing the crashes have been determined and remedial action taken. Inasmuch as there seems to be no trend established in the three crashes, it is entirely possible they are unrelated, ADC said.

News Digest

Western Electric has received $171.8-million contract from Army for continued development of Nike Zeus ICBM defense missile system, bringing total funding for the program to date to more than $1 billion. Douglas Aircraft, major Zeus subcontractor, will receive $57.7 million of new award.

Charles E. Wilson, 71, former president of General Motors Corp. and Secretary of Defense from January, 1953 until October, 1957, died Sept. 26 at his plantation home near Norwood, La.

Raytheon has received $42.4-million Navy Bureau of Weapons contract for additional production of Sparrow III air-to-air missiles, part of special congressional appropriation for stepped-up defense production.

William C. Foster, formerly head of the Gaither Committee and president of United Nuclear Corp., has been named to head the U. S. disarmament agency established by Congress at the request of President Kennedy. The agency starts operations with a $2-million budget for Fiscal 1962; $1 million from the transfer of State Department funds and $1 million in supplemental funds voted last week by Congress.

Tactical Air Command has transferred eight additional squadrons—two equipped with Lockheed F-104s and the other six with North American F-100s—to the 17th Air Force on a "temporary" assignment. Purpose of the transfer was officially described as "overseas operational training."

West German air force publicly displayed its Lockheed F-104s and Fiat G.91s for the first time last week at an air show at Furstenfeldbruck. Crowd was estimated at 500,000 people.

Deutsche Lufthansa West German airline is expected to scrap its committee-rule concept of management this week and name an operating president as its top executive during the carrier's annual stockholders' meeting in Cologne. Major contender for the post is West Germany's controversial minister of transport, Hans Seebohm.

John A. McCone, former head of the Atomic Energy Commission, was nominated last week by President Kennedy to succeed Allen W. Dulles as Central Intelligence Agency director.

White House-appointed bioastronautics panel (AW Aug. 21, p. 26) will meet in Washington, D. C., this week to hear a NASA briefing on the subject and to lay plans for the group's activities in the next few months.

Chances for Promotional Fare Plan Slim

Lower North Atlantic rates proposed in mail ballot but approval before winter slump hits is doubtful.

By L. L. Doty

Washington—Reaction to a Pan American World Airways proposal for promotional fares on North Atlantic routes, designed to compromise widespread industry differences on tariff issues, demonstrates that international airlines are still far from any accord on rate reductions.

In a last-ditch move to introduce an incentive fare that two International Air Transport Assn. traffic meetings failed to produce, IATA Director General Sir William Hildred submitted the PanAm plan to member airlines for a mail vote.

However, it appears that results of the voting will fall far short of the unanimous approval required to put the plan into effect and the industry will move into the low-traffic-density winter season without the promotional fare most carriers want.

PanAm has proposed that groups of not less than 25 persons may travel round trip across the Atlantic on scheduled jet flights at regular fares less $186 throughout the year. Between Apr. 1 and Sept. 30, group round-trip travel would be allowed on piston aircraft at $172 less than regular rates. Between Oct. 1 and Mar. 31, on piston aircraft, rates would be $165 less than regular fares.

The group fare principle, generally supported by international airlines, is aimed at offsetting the diversion of traffic from scheduled operations to charter flights, which have been growing rapidly in popularity during the past few years. Attempts to adopt a group fare plan for the North Atlantic area at special traffic meetings in New York and London last summer (AW Aug. 7, p. 36) failed because of sharp dissension over minor issues.

'Affinity Clause'

Superficial objections also appear likely to doom the Pan American plan. For example, one major carrier which had insisted that the group fare include an "affinity clause"—a major source of argument responsible for deadlocking the traffic meetings—has been conceded this point in the PanAm proposal.

But that carrier now says it will vote against the plan because it fails to allow groups to break up within Europe once they have reached the first point of arrival. The affinity clause requires that groups must have some identification as an organization. This is to prevent travelers from forming a group solely for the purpose of gaining the advantages of the low fare.

PanAm, in its proposal, also withdrew its earlier demands that groups be required to make two stops during a tour to qualify for the group fare, another condition that was a major factor in blocking agreement during the two meetings.

Specifically, the reaction ranged from the statement of one carrier that it is "now in the process of evaluating the plan" to that of another which charged that Pan American had stirred new industry antagonism by reviving issues that could not be resolved over conference tables and certainly will not be settled by correspondence.

Another Effort

The fare problem very probably will flare up as a major issue at the forthcoming IATA annual general meeting later this month in Sydney, Australia. At this time, airline chiefs undoubtedly will make an extreme effort to reach some agreement on the group fare program, but past attempts to settle traffic conference differences at general meetings have not always been successful.

On the brighter side, one major foreign flag carrier said that the proposal "at least lays a plan on the table" and that the mail vote may provide comments which could be used to fuse the proposal into an acceptable plan. Another factor that could bring about an eventual agreement on the group plan is the general fear of the declining load factors anticipated for the forthcoming winter season. Most carriers recognize the immediate need for a plan that will boost traffic volume.

Intended effective date of the Pan American plan is Nov. 1. But the schedule for balloting is so tight that failure to approve the plan initially could delay the effective date well into late winter if it is amended to the satisfaction of all members. Ballots are scheduled for return to IATA no later than Oct. 11.

If it is approved by all 17 carriers, the new tariff will be filed Oct. 12 and 13 with the governments of the airlines involved for formal approval.

Compromise Attempt

In submitting its proposal, PanAm stated that the plan does not, and cannot, conform to all views, including its own, that were brought out at the special New York and London meetings. It stated that the plan is based on the discussions at these meetings and is designed to reconcile divergent positions as far as practicable.

The proposal specifies that the group fare will be available to "members of the same association, corporation, company or other legal entity . . . which shall have principal purposes, aims and objectives other than travel. . . ."

To broaden the group market, Pan American further proposed that spontaneous group travel organizations can take advantage of the low fare, provided that each member of the group has belonged to it for at least six months prior to the starting date of the trip. Members may include their immediate families in the trip at the special rate.

All members shall be required to travel together for the entire itinerary. This condition drew the support of seven carriers at the London meeting, but five carriers argued that group members should be permitted to travel individually except during outbound and inbound legs of the full itinerary.

Solicitation of travel groups would be limited to personal letters, circulars

Carriers Seek Review

Washington—Four foreign air carriers—British Overseas Airways Corp., KLM, Sabena and SAS—have filed a petition with the U. S. Court of Claims for the District of Columbia for a judicial review of the Civil Aeronautics Board order requiring foreign air carriers serving the U. S. to submit traffic and schedule data with the Board.

In the complaint, the four carriers asserted that the CAB holds no jurisdiction over schedules of foreign flag carriers. The original order has been severely criticized by foreign flag carriers and several attempts have been made to seek a reversal.

and telephone calls addressed directly to members and to publications intended for circulation within the group. Airlines would be prohibited from selling groups by "public solicitation," which is defined by Pan American as describing the group feature in advertisements or any other writing or means of public communication, whether paid or unpaid. Use of telephone campaigns, radio, telegraph and television to solicit group business would also be prohibited.

Airlines with limited sales outlets within the U. S. are likely to protest this provision of the plan, although the Civil Aeronautics Board will undoubtedly require such a condition before giving its approval to any group fare rate.

As a concession to carriers concerned over the diversionary effects of the group rates, PanAm proposes that eastbound travel during May, June and July and westbound travel during August, September and October across the North Atlantic sector of any itinerary may not be started between 7 a.m. Friday and 7 a.m. Monday.

Other features of the plan include:

- **Full payment** of all tickets must be submitted to the carrying airline 30 days prior to the flight.
- **Each ticket** must be endorsed to show that the passenger is a bona fide member of the group.
- **Group travel organization** shall make available to the IATA enforcement office all records supporting its eligibility for the group fare discount. IATA enforcement office also shall be entitled to interview and obtain information from any member of the group.
- **Group fares** shall not be used for construction of around-the-world fares.
- **Reduced fares** for children may be applied to the group fare.
- **Free or reduced** fare transportation for a tour conductor will be prohibited.

Ox Carts to Airplanes

Washington—Senate Aviation Subcommittee Chairman A. S. Mike Monroney (D.-Okla.) has some unsolicited advice for underdeveloped nations planning a transportation system: go from ox carts to airplanes without stopping to build millions of dollars of highways.

In a recent hearing, Monroney contended that rather than build highways or prestige airlines to operate chiefly outside the underdeveloped countries, "a few airports and modern inter-regional craft could bring them forward in an economic posture far faster . . . ." He said countries should realize "the great advantage of skipping perhaps the highway and the railroad age and going directly from the buffalo cart into the air age for connecting their country."

CAB, Justice Reappraise Policies On Foreign Carriers Competition

Washington—Civil Aeronautics Board, with the help of the Justice Department, is reappraising its policies toward foreign carriers in hopes it can develop stop-gap measures to improve the competitive position of U. S. lines in the international market.

Relief actions under consideration include putting rate restrictions on foreign carriers, allowing U. S. flag carriers to enter into pool arrangements so overseas traffic can be apportioned, and letting U. S. carriers buy into foreign lines.

These would be emergency steps to give U. S. carriers temporary relief. The measures would be superseded by the new U. S. policies now being evolved at the direction of President Kennedy.

Impetus for new aviation policies comes from the widespread conviction that the U. S. government currently is putting its own carriers at a disadvantage in the fierce international competition for air traffic. There is dissatisfaction with the bilateral agreements with foreign governments and with the U. S. government inability to protect its carriers from foreign restrictions not authorized in such agreements.

Both government and industry witnesses at a recent hearing before the Senate aviation subcommittee said the situation will become worse unless prompt action is taken. Chairman A. S. Mike Monroney (D.-Okla.), for example, said the competition from foreign carriers will increase markedly once Russia starts offering cut-rate air transportation.

"We would be blind indeed," Sen. Monroney said, ". . . if we ignored the likelihood of a strong aviation drive to orient air commerce toward Moscow rather than toward the U. S. as being one of the threats we face." He added that the Senate could "ill afford to sit here and let the air transport world system reach the chaotic condition that has developed through the years in the maritime field."

CAB Chairman Alan S. Boyd noted that the U. S. carriers' share of international traffic declined from 74.7% of the total to 54.7% between 1950 and 1960. Part of the trouble, he said, stems from CAB's inability to enforce provisions of U. S. air agreements with foreign countries. Another problem, he added, is the lack of CAB authority to regulate international air fares even when it feels a foreign carrier's fare will hurt U. S. lines. Legislation giving CAB this authority was not acted upon by Congress this year.

Boyd said the CAB has not been able to keep foreign governments from imposing restrictions on U. S. carriers. "Our recourse," Boyd said, "is to lodge formal complaint of violation of the agreement, but, pending the conclusion of consultations for the review of such complaint, we are operating on the other governments' terms."

To strengthen CAB's hand in international matters, Boyd said the Board "is now considering the legal and policy aspects" of putting rate restrictions in the permits the U. S. gives to foreign carriers.

Boyd said "we are becoming increasingly concerned" with the foreign airline pools under which the carriers divide up the market among themselves. "It is apparent that a number of these [pool] arrangements involve violations of the anti-trust laws of the U. S.," he said.

The Board has asked the Justice Department to determine whether U. S. carriers forming similar pools would violate the anti-trust laws, he said. "Board policy in interpreting the Federal Aviation Act has opposed U. S. carrier participation in such pools because of their generally inhibiting effect on competition," Boyd said. "But it may be that continuing study of the matter and future developments in this area will indicate the need for a reshaping of this policy."

Citing "increasing penetration" by big foreign carriers into smaller ones through partial ownership and lease arrangements, Boyd said the Board's Cubana decision opposing the same type of ownership by U. S. carriers may have to be changed.

Edwin M. Martin, assistant secretary of state for economic affairs, told the aviation subcommittee that "the objective of the U. S. for enlightened leadership in the development of international civil air transport is being impaired by the current inability to implement U. S. international aviation policies and programs in the face of major new problems and issues."

Martin welcomed the private study of international aviation problems recently authorized by President Kennedy. Martin said the research contract is expected to cost between $225,000 and $500,000, and the study is expected to take nine months.

The staff of the Senate aviation subcommittee will conduct its own study of international air problems between now and when Congress reconvenes. Sen. Monroney said he will hold hearings early next year on international air agreements.

Ethnic Ties Push Irish Carrier's Traffic

By Glenn Garrison

New York—Stress on economy fares and exploitation of a built-in U. S. market have helped Irish International Airlines, a North Atlantic operator only since 1958, to make a respectable showing this year when most of its competitors are suffering the financial woes of a crucial overcapacity situation.

During the peak eastbound month of June, 1961, the Irish carrier achieved the highest load factor of any International Air Transport Assn. member on the route, with 80% of its seats filled. In July, Irish International's load factor was 77% eastbound, second only to El Al Israel's 81%. The Irish airline now is showing a margin of profit, and expects to be in the black at the end of 1961.

Among the factors the Irish carrier cites as favoring its operation are:

- **Ethnic market in the U. S.** of Irish descendants and immigrants, who composed an estimated 95% of the airline's business at the beginning. The carrier has been seeking to broaden its market beyond the ethnic group, and reports a reduction to 75-80% of its total business at present.
- **Low-fare philosophy** which resulted in an all-economy service until December, 1960, when the airline's first Boeing 720 jets entered service. Advertising has been, and is consistently, geared to the economy market and the jets are operated with only 12 first-class seats of a 120-seat total.
- **Market research program** which the airline says has enabled it to pinpoint its U. S. markets and to establish a formal index of potential in various areas.

Research Program

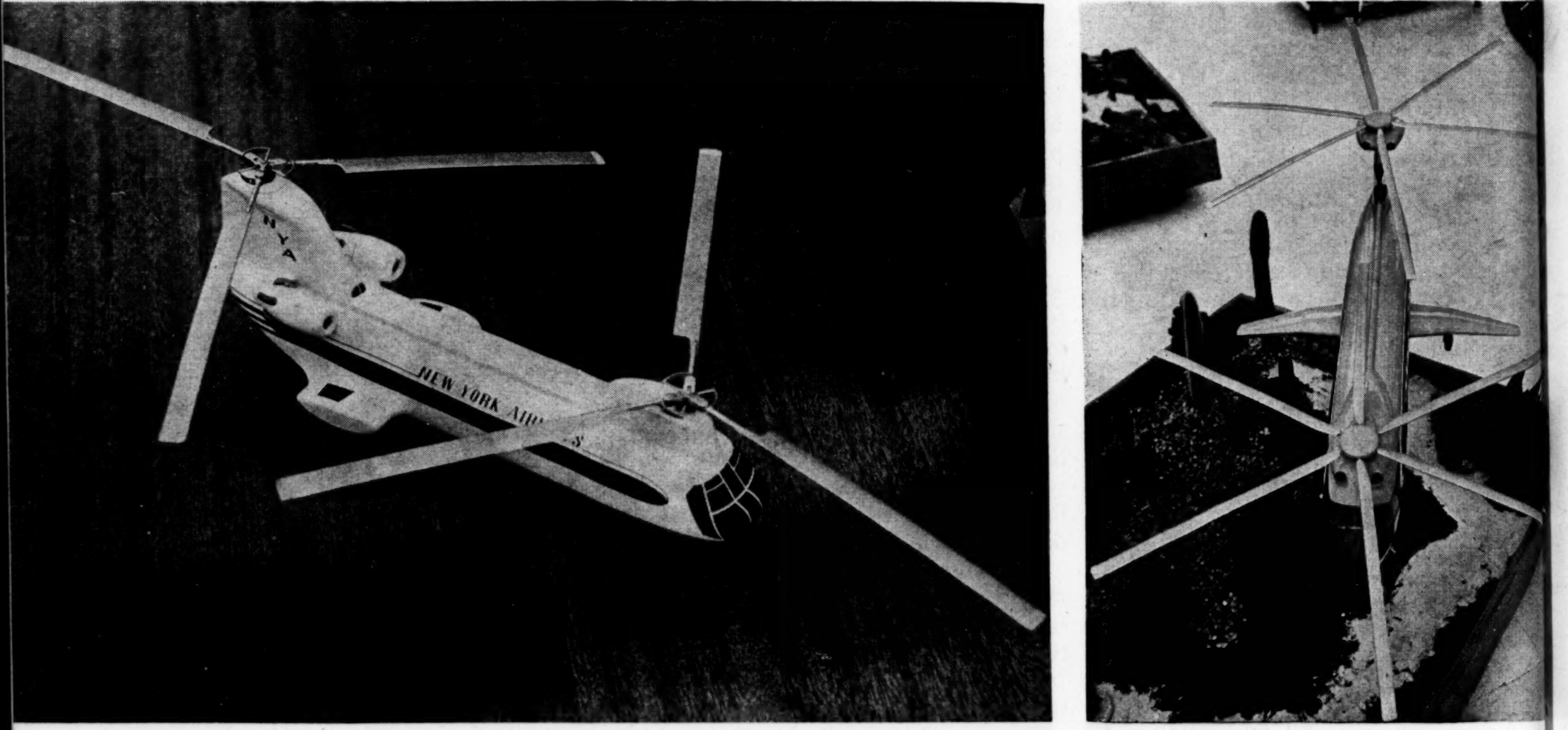
The research program, which began in late 1959 with the establishment of a market research and sales development unit in New York, involves a statistical approach which the airline says is unusual among transatlantic carriers. Most data sources within the airline industry use a seat-mile basis, according to the Irish carrier, and by departing from that criterion to a simple total-passenger basis many other sources of data become usable. These include gross national product, census data, income level statistics and the like. Factors important to Irish International Airlines include the number of ethnic Irish in a potential area, number of passports issued, religion and income brackets that are prevalent in the area.

(Religion is related to the ethnic Irish population, and for this reason Irish International advertises in Catholic newspapers.)

A formula was developed for integrating such data and this formula has been in use since last spring. The airline claims it was able to forecast monthly traffic levels to Europe both for itself and for the industry within 3-5%.

Irish Airlines' U.S. markets were pinpointed in seven major locations. Ranking in order of present importance, they are New York, Boston, Philadelphia, Chicago, Toronto, San Francisco, Los Angeles, Cleveland and Washington. However, the Cleveland area is considered greater in potential business than Chicago. Concentration of its natural markets enables the carrier to pinpoint them and derive more for each advertising and sales dollar—perhaps 50% more than other international carriers, in the airline's estimate.

In analyzing its ethnic market, Irish Airlines puts the Irish in two categories referred to as "push" and "pull." The "pull" category contains native born and first-generation Irishmen who feel a natural sentimental pull to visit the



Two British Transport Helicopter Designs Studied

Model of a twin-turbine stretched version of the 25-passenger Boeing Vertol 107 (left) was displayed at 22nd exhibition of the Society of British Aircraft Constructors, Farnborough, England (AW Sept. 11, p. 27) by D. Napier & Son, Ltd. This version, shown in New York Airways markings, would carry 33 passengers. It is being proposed by Napier in conjunction with Boeing Vertol. It would be powered by two advanced Napier Gazelle turbine engines of 2,000 shp. mounted on the aft fuselage. Model at right shows the Westland 194, civil version of the Westland Belvedere. Four de Havilland Gnome turbines would power the six-bladed rotors. Rotor heads probably would be supplied by Sikorsky Aircraft Division of United Aircraft Co. if the helicopter is ever built. At present, it is a backup design to the Westland Rotodyne project.

old sod. The "push" elements are further removed generations who must be sold, or pushed, on the sentimental values.

However, Irish International by no means expects to rely entirely on its ethnic advantages. For example, diversion of a small percentage of the tourists who visit Europe without a stop in Ireland would greatly increase the airline's traffic.

Since tourist facilities have been lacking for expanded Irish tourism, the airline is participating financially in the construction of new hotels, one each in Dublin, Cork and Limerick. Scheduled for completion in 1963, they will be operated by Irish International's partner in the project, Intercontinental Hotels Corp., a subsidiary of Pan American World Airways.

Economy Market

Irish International's sales efforts will continue to be aimed at the economy market. This agrees with its basic view that first-class business will continue to decline and the low-fare mass market is what will fill airline seats.

"The future of the Atlantic is cheap fares," James O. Leet, the Irish carrier's vice president for North America, said recently. Fare reductions are "absolutely essential," he said, particularly in the off season, but also all year-round.

Leet said he had anticipated a poor season in the summer of 1960, when Irish International was still operating leased Lockheed 1049H Constellations and most other carriers had their jets. But the piston fare was lower than jet fare, and the airline played this up in its advertising to its primarily tourist market. Result was a good summer season.

The airline is extremely conscious of the current overcapacity problem, Leet said, and plans to do its own scheduling in the future in terms of what its analyses show the market will bear. Next summer, for example, capacity is expected to be about the same as in 1961. The airline now has three jets and, Leet said, will acquire more equipment only when the need develops.

Business Travel

Irish International has found its primary market among tourists, but now is striving to acquire more business travel. However, it is gearing its promotion to business travelers on an economy-fare basis. For example, the headline for one advertisement invites corporations to cut their executive travel costs by more than one half by using 17-day economy excursion instead of traveling first class. Another ad includes a plug for the airline's first-class service, but adds "But why spend so much money? Your economy flight leaves nothing to be desired in comfort, time, or service."

It might be noted that some other transatlantic airlines recently have been advertising their economy fares against first class. But the Irish carrier points out that they are in a better position than most to sell the business traveler economy instead of first class: Until last December, they had an all-economy service anyway, and their first-class business market now amounts to very little compared with the established business of other carriers.

Airline Philosophy

As an indication of the Irish Airline philosophy regarding lower fares, Aer Lingus, which is the sister corporation to Irish International Airlines and operates to and within Europe and the United Kingdom, is now considering the introduction of a new high-density, low fare service within Europe. Instead of the present 60 seats in its Vickers Viscount 800 equipment, about 78 seats would be used in this short-haul service.

About 15-20% of Irish International's current traffic, incidentally, is now carried beyond Ireland by Aer Lingus. During the peak of last summer's season, the 720s of Irish International made several runs a day from Ireland to London on Aer Lingus routes.

During the Irish carrier's first part-year on the Atlantic, which began in late April, 1958, the airline carried 13,380 passengers in both directions. The total was 23,278 in 1959, 34,500 in 1960. This year, the estimated total will reach 43,500. Next year, a traffic increase of 20-25% is forecast.

Project Beacon Report Will Urge Use of Radar, Digital Computers

Washington—White House has sent copies of the long-awaited Project Beacon report to interested government agencies for their comments, which were due late last week.

Barring strong objections, the report, prepared by a special task force appointed by Federal Aviation Agency Administrator Najeeb Halaby and headed by Richard Hough, is expected to be released shortly.

Report Recommendations

The report will recommend that FAA make increased use of air defense radars but not adopt the SAGE computers for traffic control, as suggested by some Air Force representatives (AW Sept. 18, p. 38). Although the Beacon report recommends that radar, with altitude information provided by radar beacons, serve as the primary traffic control mechanism, it will urge use of digital computers for traffic flow scheduling and conflict prediction, both en route and in the terminal area.

The report will suggest that the Librascope computer, originally developed under FAA sponsorship as part of its new semi-automatic traffic control system, be adapted for use in the radar control system. A production version of the Librascope computer now nearing completion is expected to be installed at the new Atlanta air route traffic control center instead of in the new Boston center as originally planned (AW Aug. 28, p. 52).

Initially the Librascope computer will be used to store flight plans and print out flight progress strips, a function similar to that performed by older Univac computers installed at several other centers. As techniques for en route and terminal area scheduling and conflict prediction are worked out by FAA's National Aviation Facilities Experimental Center, the report recommends that they be introduced. However, it recommends that increased emphasis be given to terminal area scheduling, rather than en route.

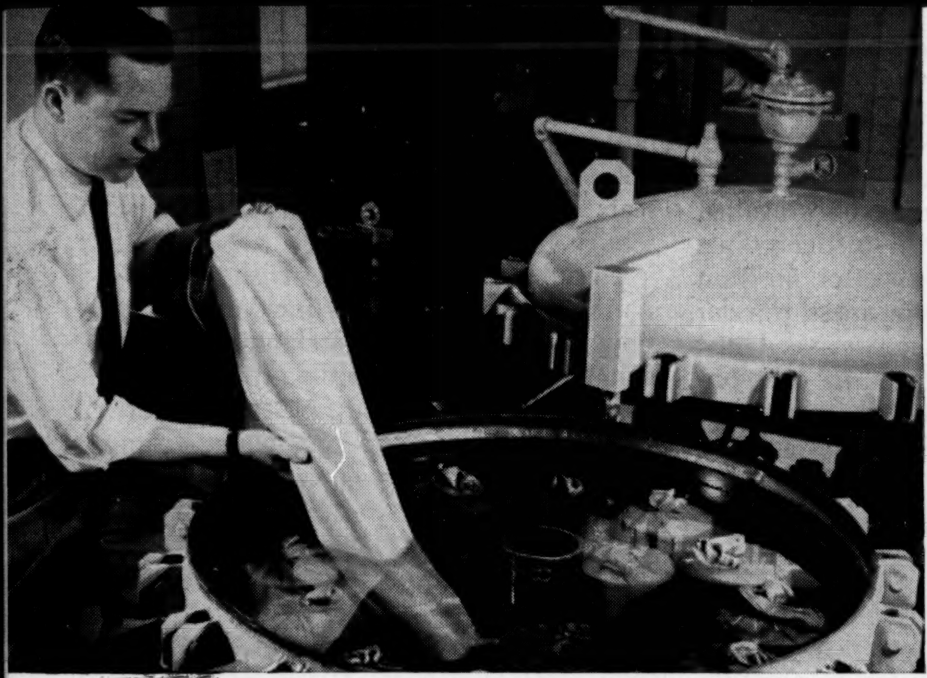
The prototype tabular bay consoles with mechanized updating of flight strips, intended as part of the original FAA semi-automatic traffic control system, are nearing completion at General Precision, Inc. and Burroughs Corp. The agency has not, so far, taken any action to cancel these programs, despite the Project Beacon recommendation that radar scopes replace flight strips as the primary controller reference.

Original Viewpoint

When FAA originally launched its traffic control system development more than three years ago, it held the view that flight strips, long used by traffic controllers, should be retained to ease the transition to the new system and to assure that failure of the new equipment would not leave controllers without data on aircraft under their control.

In the intervening period, experience gained by controllers using new en route and terminal area radars suggests a reversal of this thinking, according to the Beacon task force.

Although the report urges early implementation of radar beacons for automatic altitude control, and says this will eliminate any need for early implementation of data link, it does not urge FAA to halt its data link development studies.



LOCKHEED JETSTAR—FIRST U. S. CORPORATE TURBOJET

Left: Shell engineer tests filter-separator at the AeroShell Turbine Fuel Equipment Laboratory—first in the U. S. **Right:** New Lockheed JetStar refuels. Shell sold over one billion gallons of aviation fuel last year.

Shell Research reports on 5 advances in fuels and lubricants and discloses how they improve aircraft performance

1. First non-ash additive oil for piston engine aircraft. AeroShell® Oil W is the first fully compounded additive oil ever *approved by every major piston engine manufacturer* in the U. S. AeroShell Oil W is the first piston engine oil that does not form harmful metallic-ash deposits.

It helps keep engines cleaner, extends periods between overhauls, can even lengthen engine life.

2. Shell grease lubricates X-15 as it sets world's speed record. Twenty-four greases were tested for use on the X-15 rocket plane. Only one—AeroShell Grease 5A®—passed all tests and was commercially available.

Today, AeroShell Grease 5A guards 23 vital control points in the X-15 as it sets new speed records for manned aircraft.

AeroShell Grease 5A is also recommended for commercial and private aircraft.

3. Full-scale gas turbine research lab. Shell Research built and operated one of the petroleum industry's earliest laboratories designed to investigate fuel performance in full-scale turbine engine combustion systems. This paid off in 1955 when the first airline introduced turbine aircraft. Shell was ready with the fuel.

Shell has the most extensive turbine fuel distribution network in the nation for general aviation and sold over a billion gallons of aviation fuel last year.

Today, Shell is the leading supplier of commercial aviation fuel in the U.S.

4. First turbine fuel equipment lab assures maximum cleanliness. Shell set up the first U.S. laboratory in the industry to study turbine fuel cleanliness. Its purpose: to assure Shell's ability to deliver uniformly clean fuel to your airplane.

As a result, today's Shell turbine fuel is of outstanding quality. You can buy it with absolute confidence.

Whatever plane you fly, wherever you fly it, Shell's experience in aircraft fuels and lubricants assures you of top performance.

5. Shell and fuels of the future. Shell has developed a special hydrocarbon fuel for Mach 3 flight. But the craft that will use it have yet to be perfected. When they are, Shell will be ready.

Shell rocket fuel—UMF®-C—is today powering the first-stage boosters of many of today's satellite vehicles.

Special note to airport dealers

SHELL offers independent dealers a complete range of assistance.

Shell's technical representatives are backed up with the solid experience and technical know-how that has made Shell the nation's top supplier of commercial aviation fuels.

Shell's advanced products and reputation with pilots assure that you will stay profitably ahead with a Shell dealership.

Contact your Shell District Office for details. Or write: Shell Oil Company, 50 West 50th St., New York 20, N. Y.

SHELL

A BULLETIN FROM SHELL
—where 1,997 scientists are helping to provide better products for industry

Northeast Balks at Terms for Merger

New York—Northeast Airlines' "continued financial deterioration" will necessitate changes in the merger-dismemberment proposal made by Eastern, National and Mohawk (AW Sept. 25, p. 354) to reflect Northeast's delay in agreeing to the plan, a representative of the three carriers said last week.

Extending a Sept. 26 deadline for decision that Northeast—which has serious objections to some aspects of the proposal—failed to meet, the three carriers wrote Northeast Chairman David A. Stretch that ". . . specific financial considerations involved in the offer must be subject to adjustment reflecting the delay."

Last week Northeast refused comment on the implied financial penalties for delay, but said that prompt and proper consideration would be given to the extended proposal. Because of the difficult questions concerning legal and practical feasibility of the plan, it has been referred to legal counsel for review and recommendation, Northeast said.

Expressing willingness to meet with representatives of the three carriers, Stretch said in a statement that CAB had already made a Northeast merger a subject of consideration in the current Florida route renewal procedure and that the three carriers' proposition as well as any others would be considered on its merits.

Moreover, Stretch said, Northeast's renewal application "is being vigorously opposed" by Eastern and National.

The three carriers wrote Stretch Sept. 22 and advised him that their proposal, dated Sept. 15, had not been answered and ". . . the financial condition of Northeast continues to deteriorate." Hence, the proposal would be withdrawn unless by 5 p.m. Sept. 26 Stretch indicated ". . . your acceptance of and/or your willingness to recommend such a proposal in principle, as chairman of Northeast and president of Atlas."

Stretch replied Sept. 26 that the deadline was inconsistent with the other carriers' stated intention to leave the offer open for a reasonable time. Northeast had had about one working week to consider the complex proposal, Stretch said. There are "serious unresolved questions as to the legal and practical feasibility" of the proposal, Stretch said. These include the proposal that only specified obligations will be assumed by the merged company and only specified assets applied to obligations not assumed, leaving Northeast with the burden of satisfying obligations. (The proposal, among other things, would relieve the merged company of $26 million of debts that are held by Hughes Tool Co. and the Atlas Corp., and the merged company would not be responsible for Northeast's trade accounts outstanding.)

Stretch also said the proposal does not resolve difficult questions relating to the relative rights of creditors, or rights of stockholders in relation to such creditors; is subject to conditions over which Northeast has no control; and is predicated in major part ". . . upon an asserted need to restore sound economic conditions in air transportation in the territory served by Northeast."

Regarding the New England routes, the proposal would help restore economic conditions, Stretch said, but in the case of Northeast's routes south of New York, the airline is "by no means prepared to concede" the existence of unsound economic conditions in air transportation.

Practical problems in connection with the proposal, Stretch said, include the burden of expenses which would be involved in carrying out the plan. Stretch said Northeast is not now in a position to commit itself "because of the uncertainties inherent in your proposal, the nature of the conditions which you have specified and the short period of time which is now permitted us for consideration of the problems involved."

Answering Stretch in a letter dated Sept. 27, the three carriers described Stretch's objections as "for the most part a recapitulation of problems involved in any merger." They are recognized, the carriers said, as requiring careful and skillful handling on both sides.

The offer of Sept. 15, the carriers said, is not withdrawn and is continued in effect until further notice. But the financial considerations, they noted, must be subject to readjustment because of the delay.

Examiner Approves Riddle Merger

Washington—Merger of Riddle Airlines and Aerovias Sud Americana, which would give Riddle through-plane cargo service from interior U. S. points into 13 Latin American countries, has been recommended by a Civil Aeronautics Board examiner.

If the merger receives approval of the Board and the President, the Aerovias route system would give Riddle access to certain points in Mexico, every Central American country, the South American countries of Colombia, Ecuador, Peru, Venezuela and a point in Brazil.

CAB Examiner James Keith found that the two systems, which meet in Miami, would "integrate perfectly." Riddle currently holds authority to operate domestic cargo flights between Miami and Boston via New York, Philadelphia, Baltimore, Washington and several Florida points. Another segment allows Riddle to fly between Miami and the co-terminals Chicago and Detroit via Indianapolis, Cincinnati, Cleveland and Atlanta. Riddle also has a New York-Miami-San Juan, Puerto Rico route.

Aerovias is operating only over portions of its authorized route system. It now operates two flights weekly between Florida points and Ecuador, via the Canal Zone, and a weekly flight between Florida, El Salvador and the Canal Zone. Riddle has indicated that if the merger is approved, it initially would operate only on part of the Aerovias system.

Pan American Airways, Braniff Airways, and Panagra opposed the merger, on the grounds that it would give Riddle a competitive advantage.

PanAm, Braniff and Panagra have raised some doubts about Riddle's ability to operate profitably over the Aerovias system.

In rejecting the protests of Pan American and Panagra, Keith noted that both carriers have applications before CAB seeking to expand their own systems to provide service similar to that Riddle would have under the merger. Keith said CAB had recognized that combination carriers like Pan American and Panagra belonged to a different class than all-cargo carriers. CAB from the beginning of the all-cargo experiment has accorded cargo lines separate treatment, Keith said. On this basis, Keith felt, the Board is not compelled to give special consideration to the objecting carriers.

Terms of the merger call for Riddle's offering to buy Aerovias stock at $1.25 per share for common stock and $6.375 for preferred stock. Aerovias has 146,238 shares of common and 20,088 shares of preferred stock outstanding. Or, Aerovias stockholders could exchange common stock for Riddle common stock on a one-to-one basis. One share of Aerovias preferred stock would bring 5½ shares of Riddle common stock. If all Aerovias stockholders elect to be paid in cash, cost to Riddle would be $311,058. Aerovias currently owns one DC-4 and one C-46 aircraft.

Changes in MATS' International Service Rates Proposed by CAB

Washington—Changes in Military Air Transport Service rates for international operations have been proposed by Civil Aeronautics Board after a survey of the military charter industry's operations under minimum rates set a year ago.

CAB set the minimum rates on Oct. 1, 1960, after an extended period of losses by contracting carriers. In a study aimed at improving criteria for minimum rate determination in the light of one year's experience, CAB asked interested airlines for suggestions to improve rate making practices.

The Board asked contractors to submit figures for operating incomes and expenses for the first year of operation under rate floors. It also requested projections of operating costs for Fiscal 1962 reflecting the use of turbine powered aircraft such as the Canadair CL-44 and Boeing 707. MATS was also asked to contribute any information that might help establish satisfactory rate standards.

As a result of the study, CAB made recommendations that changes of minimum rate policy be made in four areas:

- **Minimum rate levels.** The impact of larger, more economical turbine powered aircraft on the MATS charter market has led CAB to propose lower rates for certain MATS operations. Proposed minimum rate for round-trip passenger charters is 2.7 cents per passenger mile. The present rate is 2.9 cents per passenger mile. The present one-way rate of 4.2 cents per passenger mile would remain because CAB feels it is properly related to operating costs.

Round-trip cargo charter rates would be dropped from 13.75 cents per ton mile to 12 cents. One-way cargo charter rate would be lowered from 22.5 cents per cargo mile to 21.5 cents. Convertible (passenger one-way and cargo the other) charter rate for round trips would be 13.8 cents per ton mile instead of 16.5 cents.

- **"Open-jaw" flights.** Round-trip flights with a non-revenue leg—a portion of the trip where the aircraft travels empty—have been a long-time problem for MATS. These "open jaw" flights are now contracted at the one-way rate for each leg. Proposed rule changes would make this type of operation a round-trip flight for rate purposes, subject to three limitations.

One limitation provides that round-trip flights may not terminate at any airport over 250 mi. from the point at which the trip originated. This will allow the military to use different airports in the same general area without extra costs. CAB figures that the carriers' costs need not go up since they usually have to ferry the aircraft to and from the point of origin anyway.

Another limitation provides for a non-revenue ferry leg en route, not to exceed 50 statute miles. This would allow nearby airports to serve as turnaround points. The final restriction is a provision for a ferry flight en route not to exceed 500 miles at one-half the regular rate.

- **Rate making mileage.** Mileage used as a basis for minimum rate calculation would be nonstop statute miles from airport-to-airport via any intermediate points in the contract. Exception would be made for transpacific charters. Pacific mileages would be based on a minimum one-stop operation via either Alaska or Hawaii, whichever is the shortest distance.
- **Minimum cabin loads.** Provision will be made for specification of minimum cabin loads for additional types of aircraft as they become available for use.

The new rates, if adopted by the Board, will affect Fiscal 1962 MATS contracts let last June. Contracts have a clause providing for rate revision in the event the CAB makes any change in rate policy. CAB hopes the new rate policy will allow carriers more managerial flexibility and at the same time pass on to MATS several million dollars in savings resulting from use of modern equipment.

Pan Am Heliport Hits Snag

New York—Negotiations between New York Airways and Pan American World Airways over operation of a heliport planned to top the 57-story PanAm Building, now under construction here, have been snagged by a dispute over allocation of the heliport's traffic capacity.

PanAm wants indirectly to restrict the number of charter services New York Airways would be able to provide for PanAm's competitors in connections between Idlewild and the Manhattan heliport. New York Airways, on the other hand, doesn't want to serve PanAm passengers exclusively in the charter operations expected to operate at certain times of day to connect with international flights. Common carriage services are not involved.

PanAm has already signed an agreement with Grand Central Building Corp., owner of the building, under which PanAm will pay half the cost of the heliport construction. But New York Airways, if it is to be the operator—as it is almost certain to be—must be a third party to the agreement, and is understood to have balked at the degree of control allocated PanAm.

PanAm probably will construct another heliport on its own terminal at Idlewild so it can have direct service between it and the midtown New York facility. The airline is chief lessee of space in the PanAm Building, which is scheduled for completion in 1963.

BOAC Opens Appeal On Cunard Decision

London—British Overseas Airways Corp. last week opened its appeal against a British Air Transport Licensing Board decision in favor of allowing Cunard Eagle Airways to operate two Boeing 707-420s from London to New York on a daily schedule.

BOAC's appeal stresses that a drop of 11% in transatlantic traffic this summer under last year (AW Aug. 14, p. 52) and that the entry of Cunard Eagle on this route will result in a material diversion of traffic from BOAC.

BOAC also contends that the board grant to Cunard Eagle is a strange decision, an almost perverse one, since the board's ruling acknowledged there would be some diversion from BOAC. BOAC's view is that the diversion will be wasteful in view of BOAC's heavy commitment for Vickers VC.10 jet transports (15 VC.10s and 30 Super VC.10s).

Jet Transport Skids Into Harbor at Boston

American Airlines Boeing 720 turbofan transport with 71 persons aboard last week overshot a 7,500 ft. runway at Boston's Logan International Airport and skidded off the field into eight feet of water in Winthrop Bay, coming to a stop some 30 ft. from land. All persons aboard were rescued by pleasure boats in the area.

Plane skidded about 400 ft. on landing, veered to the right across land for an estimated 100 ft. before skimming into the harbor. Pilot of the aircraft, Captain T. E. Jonson, made the landing under instrument conditions in foggy weather. The accident occurred at 11 a.m. Sept. 24.

Both port engines, nose wheel and landing gear were ripped from the fuselage when the plane hit the water.

Consortiums Urged for SST Development

Delft, Holland—Political and technological consortium agreements between Western European nations and the United States should be reached to speed development of supersonic transport aircraft, Georges Hereil, president of France's Sud Aviation believes.

The company presently is developing a Mach 2-plus airliner based largely on its Caravelle experience.

Delivering the Albert Plesman Memorial Lecture in Delft, Holland, Hereil declined to side with either faction in the current dispute over required performance for such an aircraft—Mach 2-plus as the British industry contends, or Mach 3-plus as most U. S. spokesmen demand. He said, instead, there is room for both, Europe concentrating upon a Mach 2.2 "transcontinental" aircraft, the U. S. upon a Mach 3.5 "transoceanic" transport. He told the Delft audience:

"It would seem that, in the matter of supersonic aircraft, there are two potential fields:

- "**An aircraft seating** roughly 100 passengers, economical to operate over distances of from 1,250 to 2,800 mi. and capable of flying at Mach 2.2, i.e., constructable with the materials used in the present manufacture of aircraft. Such an aircraft would be called 'transcontinental.'
- "**A 'transoceanic'** aircraft which, according to preliminary calculations, would pay its way if it were made to fly at a speed of roughly Mach 3.5 and which would therefore require steel in place of light alloys."

Cost of each program, Hereil said, would be such that "no single aircraft constructor or any single group of aircraft constructors . . . [could] afford to risk such enormous sums, for the performance of supersonic aircraft is so extraordinary that relatively few of them are ever needed." He estimated development costs for the Mach 2.2 aircraft, including instruments, equipment, engines, tools and testing, at approximately $400 million. Similar costs for the Mach 3.5 transport would be about $600 million, Hereil said, adding:

"There is one simple conclusion to be drawn from all this: that in this particular field, private enterprise must give way to an inter-state organization. I should like the West to realize this and to undertake accordingly a work of wholehearted cooperation at the international level."

On the European side, Hereil said, the French and British governments "could draft the essential features of a common policy with which the governments of the other aircraft-producing countries of the West—Belgium, Germany, Holland, Italy, Spain, Sweden and Switzerland—could become associated."

French and British government and industry spokesmen have been discussing such an agreement for some time now with no positive results thus far. As a possible partner—or competitor—for Hereil's Super Caravelle project is the British Aircraft Corp., which recently completed the design of a 130-passenger Mach 2.2 transport, a highly swept delta with a wing resembling that of the Handley Page 115 research plane (AW Sept. 18, p. 47).

In his speech, Hereil said, "The manufacturers are ready to take this new turning" toward cooperative development, although in France Sud and Dassault, named by the government to cooperate on a supersonic transport, apparently have not yet been able to agree on a uniform design.

"The manufacturers have accepted their responsibilities: it is now for the governments to speak," Hereil said.

Once the European consortium has been arranged, "a second negotiation would then follow between the European governments on the one hand and the U. S. government on the other to divide and allocate the work on the projects in question—the U. S. government undertaking to support the transoceanic project and Europe the transcontinental.

"Both American and European constructors would have complete freedom of initiative."

Hereil, however, in possible reference to the inroads shorter-range versions of the Boeing 707 transport and other aircraft have made into Caravelle market areas, laid down a sharp dividing line between the two efforts:

"The agreement should be made . . . that any state aid they might receive—whether directly or indirectly—must serve to promote such over-all cooperation of efforts as would ensure that two sources of aircraft, both complementary, were created with the transcontinental reserved for Europe and the transoceanic reserved for the U. S."

Most U. S. discussions in this field envision large amounts of government aid, both in money and design contributions, as do their European counterparts.

Reverse Thrust Landing Method For DC-8s Is Ordered by FAA

Washington — Federal Aviation Agency, acting after a series of incidents in which Douglas DC-8s veered off runways shortly after touchdown, last week instructed U. S. airline operators to use a new reverse thrust procedure to slow DC-8 landings without hydraulic brake pressure.

Reverse thrust should not be applied until all of the transport's wheels are firmly on the ground, the FAA directive said. Outboard turbojets should not be reversed until the DC-8 pilot ascertains that the plane's inboard engines actually are producing reverse thrust, it warned.

On the DC-8, a series of lights warns the flight crew when the aircraft's thrust reverser buckets have assumed the proper position after landing. Possibility that this light circuit may chronically malfunction now is being studied by an FAA team investigating recent turbojet landing incidents.

FAA also is studying whether touchdown impacts could move thrust reverser buckets out of reverse position, thus creating an extreme asymmetric thrust situation that many believe to be responsible for the DC-8 incidents involving swerves off the runway.

Because turbojets have been landed safely with brakes locked on one side, or with nosewheels cocked at sharp angles, some investigators reason that only asymmetrical reverse thrust could produce off-runway turns sharp enough to result in loss of control.

Douglas, Boeing and Convair have been visited by FAA's hydraulic malfunction trouble-shooting team, as have the maintenance bases of every carrier operating U. S.-built turbojets. Their comprehensive report on jet hydraulic problems should be forwarded to FAA Administrator N. E. Halaby sometime this month.

Meanwhile, at Halaby's direction, FAA air carrier inspectors are giving short tests to an industry-wide sample of DC-8 aircrews to determine whether airlines have trained their pilots adequately on DC-8 hydraulic emergency procedures.

Preliminary statistics show that the frequency of DC-8 hydraulic malfunctions is not "substantially higher" than comparable Boeing 707 and Convair 880 malfunctions, an FAA engineer told Aviation Week. Most of the problems, he said, occur near the high pressure side of the system where pump output averages 3,000 psi.

FROM
THE "JENNY"
TO THE JETS

SINCLAIR HAS SERVED AVIATION, BOTH COMMERCIAL AND MILITARY, AS A PRIME SUPPLIER OF FUELS AND LUBRICANTS. THERE IS NO BETTER PROOF OF RELIABILITY.

Sinclair
AIRCRAFT OILS
SINCLAIR REFINING COMPANY
Aviation Sales, 600 Fifth Ave. • New York 20, N.Y.

Sinclair

American, Flying Tiger File Cargo Tariffs

By James D. Hendricks

New York—American Airlines and the Flying Tiger Line have filed separate proposals with Civil Aeronautics Board for new air freight tariff structures, each carrier taking a different approach to the longstanding problem of air cargo volume growth rate.

American's proposal, a streamlined and highly simplified "single rate" covering virtually all commodities and offering volume discounts and lower rates for non-peak shipping hours, will go into effect Oct. 23, subject to CAB approval.

Flying Tiger has proposed a new tariff structure which retains rate differences for types of commodities but provides for an over-all lowering of hundreds of rates on many items from a general average of about 18½ cents per ton mile to 13½ cents per ton mile. Flying Tiger wants to put the new rates into effect Oct. 16.

While CAB has not officially approved either proposal, the board in the past has publicly encouraged carriers to seek new methods for increasing cargo volume.

American executives termed their proposal as an "attempt to bring order and simplification into air freight tariffs," pointing out that the several thousand commodity rates now in use create bottlenecks in moving air freight.

One official said that American expects its return to remain at approximately the same level under the proposed new single rate structure, even without an increase in cargo volume, although the line hopes to attract more volume with the new tariff. American grossed almost $25 million from air freight in 1960 and has experienced record high months this year. In August, the carrier logged more than 11 million ton miles of air freight, a monthly record for domestic carriers.

The "single rate" tariff was developed by American after 18 months of study, using electronic data processing equipment to establish uniform point-to-point rates, volume discounts, non-peak discounts and other standards.

The proposed American tariff structure is keyed to:

- **Tapered rates** which decrease as shipment distance increases.
- **Directional rates,** which follow the traditional air freight principle of lower rates for eastbound shipments compared with westbound.
- **Volume discounts** for large shipments. These range from 75 cents off per 100 lb. for 1,000 lb. shipped over distances of 501-1,000 miles to $4 off per 100 lb. for 10,000 lb. shipped more than 1,800 miles. Discounts from the rate per 100 lb. are provided for cargo loads of 1,000, 2,000, 3,000, 5,000 and 10,000 lb.
- **Promotional rates** for shipments arriving at the airport during the non-peak air freight hours of 9 a.m. to 3 p.m. on major long-haul routes. Discounts of 25% off the proposed single rates will be offered on non-peak shipments between New York and Chicago and between Los Angeles or San Francisco and Boston, Cleveland, Detroit, New York or Chicago.

Eugene C. Taylor, American's vice president-cargo, said the single rate proposal will result in lower rates than now offered on some commodities and higher rates on others. He added that volume discount appeal would be enough to offset any loss of revenue from shippers who will face higher rates if the proposal goes through.

The only commodities excluded from the single rate in American's proposal are such items as animals, which require special handling and will bring higher rates than the standard, and a few perishables, such as flowers and vegetables, which will draw lower rates.

American officials listed these examples of the proposed single rate:

A 100-lb. shipment from Los Angeles to New York will cost $17.90 where previously the charge ranged from $15.95 for commodities such as nuts and bolts to $26.60 for some electrical appliances and parts. The New York to Los Angeles rate will be $23.75 per 100 lb., following the directional rate.

From San Francisco to Chicago, the new 100-lb. rate will be $13.90 compared with a present range of $12.25 for pharmaceuticals to $20.35 for automobile parts. The Chicago to San Francisco single rate will be $18.50.

American executives are not concerned about possible revenue losses that might be attributable to bulky commodities which would require large amounts of shipping space and yet would be charged lower rates under the proposed tariff.

Virtually all of American's cargo runs under 250 cu. in./lb., an official explained. The very few items which would exceed 250 cu. in./lb. would be charged for two pounds under a rate which American has used since it entered the air freight business 17 years ago.

Flying Tiger's proposed tariff structure, under development for two years, is designed to "establish a flexible tariff structure geared to the actual cost of transportation and provide the air freight industry with its first opportunity to break out of its traditional role as a mere emergency carrier of goods," a company official stated.

"We're courting customers who now use surface transportation," one official remarked. "We don't feel that a single rate proposal necessarily will lure these shippers away from surface transport."

Flying Tiger's proposal is keyed to its acquisition of Canadair CL-44 transport aircraft, four-engine turboprop, swing-tail freighters which the company claims can carry 65,000-lb. payloads at 400 mph. for less cost than other air freighters now in use.

Flying Tiger's tariff proposal separates commodities into seven classifications based on density or weight per cubic foot, with higher-density cargo loads subject to lower rates.

Rates are based strictly on mileage between origin and destination. Only one weight break is included in the class rate structure, a rate reduction established for shipments weighing 5,000 lb. or more.

Following are sample rate reductions:

- **Westbound** – Electrical equipment, 10,000 lb. from Boston to Los Angeles, from 28.15 cents per pound to 17.8 cents; aircraft engines, 9,000 lb. from Hartford to Seattle, from 23.5 cents to 15.7 cents; printed matter from Chicago to San Francisco, from 20.35 cents to 12.7 cents.
- **Eastbound**—Auto parts from Los Angeles to New York, from 26.6 cents to 16.8 cents; scientific instruments from Los Angeles to Chicago, from 19.6 cents to 11.9 cents; seafood, 10,000 lb. from Seattle to New York, from 13.9 cents to 10.5 cents.

Soviet Bush League

Moscow—Aeroflot has been accused of letting its bush plane services in Siberia deteriorate while concentrating on the expansion of jet and turboprop operations along Russia's trunk routes.

Residents of the rugged area east of Lake Baikal complain that the single-engine Yak-12 is being used for flights that should be made with faster, longer-range twin-engine craft having greater payload capacity. They say that a plane such as the Antonov An-14 "Pchelka" (Little Bee) is badly needed, but no one seems to know when this new short-haul transport will go into service.

One resident of the Baikal back country described the vagaries of Siberia bush flying to a Moscow reporter: "When a plane is available, there's no pilot; and when there's a pilot, there's no plane. When there are both a plane and pilot, you can't buy a ticket. And when plane, pilot and ticket are all available, the weather's too dirty for flying."

Air Traffic Control Reserve Proposed

Washington—Next session of the 87th Congress will be asked to act on a Federal Aviation Agency proposal to create a Federal Aviation Service composed of air traffic control personnel who could be ordered to military service during times of crisis.

Twin bills calling for such a service were introduced and sent to House and Senate aviation subcommittees just before Congress adjourned last week.

FAA Administrator N. E. Halaby said the Federal Aviation Service (FAS) should remain "basically civilian" in character. But "when deemed necessary in the interest of national defense by the Secretary of Defense," the FAA administrator should be authorized to place "selected members and selected elements" on military status, he said.

In addition, the legislation would empower the President to call up the entire Service during war or national emergency, thus placing every member under the Uniform Code of Military Justice. As a result, the government could count upon uninterrupted air traffic control for both military and civilian aircraft despite the circumstances.

Recommended by the Project Horizon report last month (AW Sept. 11, p. 35), the FAA proposal was set forth in a 55-page study entitled "Special Personnel Problems in the Federal Aviation Agency." Now 21 months overdue, this study was to have been submitted to Congress not later than Jan. 1, 1960, under Section 302(g) of the Federal Aviation Act of 1958.

In a letter of transmittal accompanying the report and attached draft legislation, Halaby disclosed that formation of a Federal Aviation Service had been found "consistent with the objectives of the Administration" by the Bureau of the Budget. Department of Defense, Halaby said, also is "in full agreement with the fundamental aspects" of the FAS proposal.

This broad intra-agency agreement seemed in ensure the bill's smooth passage through Congress. However, Halaby was careful to point out that "several years" would be required for FAA to assume full responsibility for all military air traffic control functions, thus implementing a national policy goal. As detailed plans are developed and submitted to the executive branch for review, the present bill may be modified by amendments, he said.

Although initial controller reaction to the FAS proposal had not taken shape last week, benefits promised FAS members by other sections of the FAA report minimized the possibility of serious discontent. Pointing out that "membership in the FAS would be a condition of employment" for many holding essential FAA positions, and that these employes may be made members of the Armed Forces "at any time without notice," the report recognized that this factor warranted extra compensation. It therefore suggested that FAS members be eligible for veterans' benefits.

These would be granted to Federal Aviation Service personnel "in the same manner and to the same degree" as they are to members of the Armed Forces. FAA also said that it is studying additional "special" benefits to make FAS service more attractive. As it now stands, the bill allows any FAS member over age 50 to retire from the Service if he has accumulated 20 years of FAS or air traffic control experience.

Among other recommendations included in the report:

- **FAA employes** should receive "relocation allowances" to reimburse them more fully for expenses incurred during permanent changes of duty station.
- **Working conditions** of all Air Traffic Service personnel should be improved with special emphasis on providing adequate breaks during each day of their 40-hr. work week, decreasing interior noise levels, installing air conditioning and improving illumination.
- **Controllers** should be limited to a 6-hr. active work day. To establish these new work schedules, FAA plans to seek new appropriations from Congress.
- **Congress** should ease certain restrictions so that FAA can pay highly educated technical personnel salaries competitive with those offered by private industry. The inability to attract key engineers is an especially acute problem in FAA's research and development program, the agency points out.
- **Legislation** should be passed to enable FAA to set an upper age limit on otherwise qualified applicants for air traffic controller positions. This is because the Agency loses approximately 50% of its ATC trainees over age 36, as opposed to only 10% of those below age 36, during their first 18 months of employment.

Convair 880-M Delivered to FAA

Convair 880-M has been delivered to the Federal Aviation Agency for use in training FAA inspectors and for tests which will be part of the agency's over-all flight safety program. Transport, shown in FAA markings, is taking off from Lindbergh Field, San Diego, Calif. Plane was flown nonstop to Oklahoma City, Okla., headquarters for FAA ground school and flight training operations.

SHORTLINES

▶ **Air Traffic Control Assn.** will have its sixth annual meeting and Air Traffic Control Exposition Oct. 30 at the Deauville Hotel, Miami Beach. The association urges pilots and system engineers to join in workshop sessions to seek solutions to urgent air traffic problems.

▶ **American Airlines** has begun installation of a $300,000 compressor shop at its Tulsa maintenance base. There, American's technicians can overhaul engine-driven and turbo compressors used for ventilation, pressurization and air conditioning aboard Electras and Boeing 707s. First overhauls are due to begin Nov. 1.

▶ **Bahamas Airways** has reduced fares between Nassau and six of the Outer Islands. Sample reductions: Nassau-Cat Island $24.30, from $29; Nassau-San Salvador Island, $37.80, from $43.

▶ **Braniff International Airways** passengers no longer must reconfirm reservations on return flights. The airline said that increased capacity made reconfirmation unnecessary. The rule was adopted in 1957 to ease the "no show" problem.

▶ **Central Airlines** reports passenger traffic for August at 23,696, a 47.1% gain over the same month last year.

▶ **Federal Aviation Agency** has begun a program to simplify FAA safety rules. This involves boiling down six or seven thousand pages of regulations into one document containing about 60 simplified rules.

▶ **Landing flares** are no longer required aboard aircraft operating over water at night. FAA allows operators to carry flares as optional equipment.

▶ **Northwest Airlines** will begin through-plane, all-cargo service between New York and Tokyo via Chicago, Seattle-Tacoma and Anchorage on Oct. 30. Initial service will be one round trip weekly with a Northwest DC-7CF air freighter.

▶ **Thai International Airways** is seeking to extend its route system to Manila, Philippines.

▶ **Trans World Airlines** will begin direct service from New York to Cairo and New York to Tel Aviv with Boeing 707-331 jet equipment on Oct. 29. Both flights will be three round trips weekly.

AIRLINE OBSERVER

▶ Sikorsky Aircraft has begun briefing airlines on its S-65 concept, based on its S-64 turbine-powered flying crane. Aimed at the short-haul market, the S-65 would carry 60 passengers at a speed of 150 kt. American Airlines, Eastern Air Lines and Trans World Airlines were included in initial briefings.

▶ Trans World Airlines Caravelle 10A transports, powered by the General Electric CJ805-23C turbofan engine, will have nacelle and engine pylon modifications to reduce drag, permitting an increase in limiting Mach number to Mach .81. Sud Aviation had started production of one or two Caravelles based on an American Airlines order once nearly signed, but dropped later when American bought Boeing 727 turbofan transports instead. These Caravelles will be acquired by TWA and modified to Caravelle 10A configuration as far as possible.

▶ British Overseas Airways Corp. is self-insuring its Bristol Britannia and Douglas DC-7 aircraft in the 1961-1962 fiscal year. Terms offered by underwriters for hull insurance for the entire BOAC fleet were rejected as too high by the carrier, but further negotiations for coverage of the Boeing 707s and de Havilland Comets led to a more satisfactory offer and these airplanes are now fully covered by insurers.

▶ Federal Aviation Agency is expected to issue a technical service order (TSO) authorizing airlines to carry miniature rescue beacons operating at a frequency of 121.5 mc. instead of the heavier, less effective "Gibson Girl" which operates at 8.6 mc.

▶ Russians may be developing a new jet transport with aft-mounted engines in the Caravelle pattern but with T-tail configuration similar to that designed for the Vickers VC.10. Photographs of a Communist Party reception for Cosmonauts Gagarin and Titov in Moscow show in the background a model of such a transport with Aeroflot markings. Discernible details include a long dorsal fin or spine extending forward to the wing and a sawtooth wing leading edge. The airplane, which is much larger than the Caravelle, appears to be powered by two exceptionally big turbojet or turbofan engines. It is probably a Tupolev design.

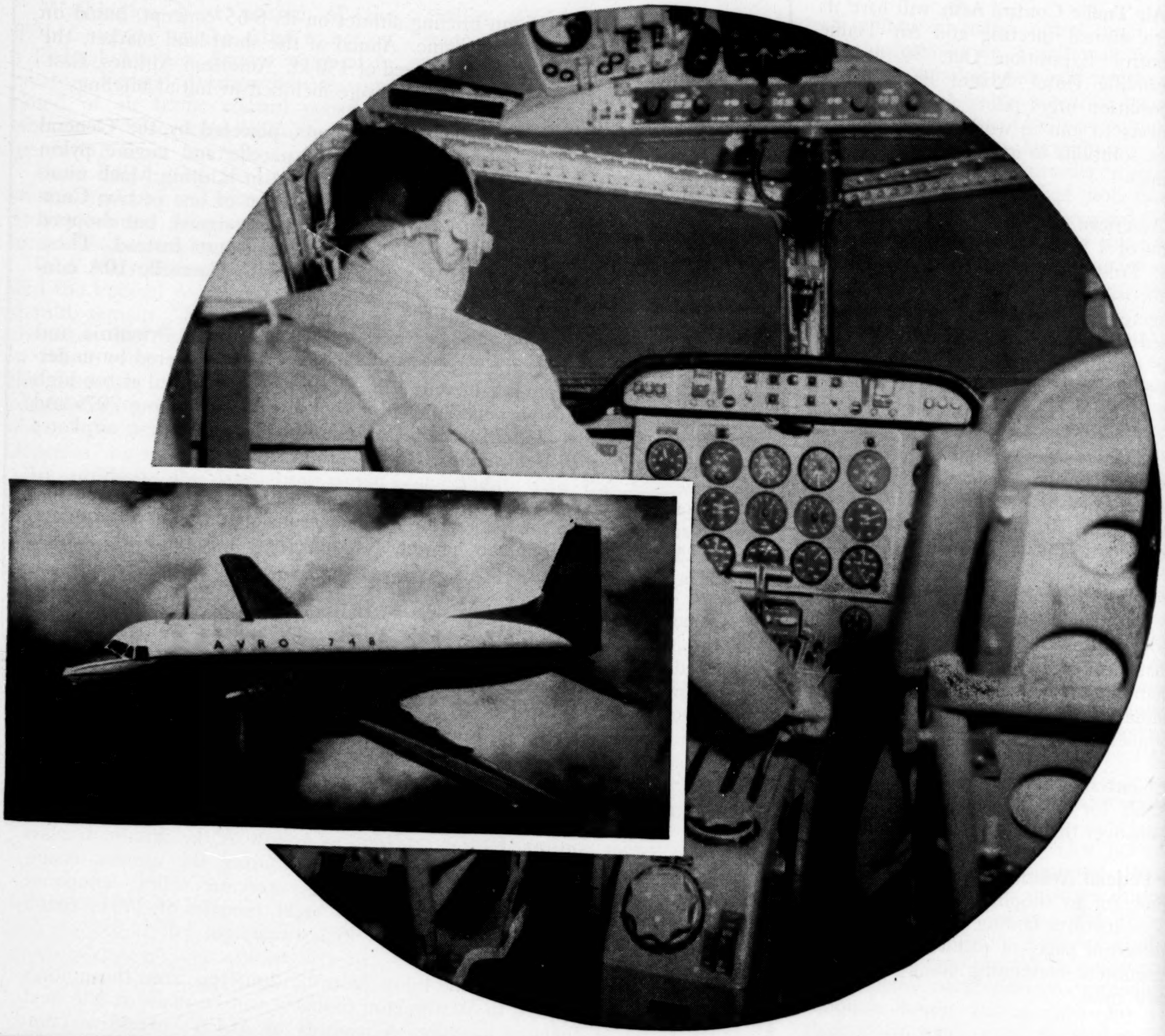
▶ Coach service continued to expand during August as the dominant class of traffic carried by the domestic trunklines. During the month, coach service accounted for 63% of total passenger revenue miles, compared with 54% in August, 1960. For the first eight months of 1961, coach was 56% of total passenger miles against 48% a year ago.

▶ Decision to move the Air Line Pilots Assn. headquarters from the union's own building in Chicago to Washington probably will be made at the next ALPA board of directors meeting. A majority of ALPA's executive committee apparently has convinced union President Clarence Sayen that the transfer is advisable in order to improve liaison between ALPA and the Federal Aviation Agency.

▶ Lufthansa German Airlines will equip its entire jet fleet with the DN-101/NC-103 doppler radar navigation system manufactured by Collins Radio Co. Installation and maintenance will be handled by Collins Radio Co., GmbH., of Frankfurt.

▶ Nigerian Airways delegation has completed talks with Aeroflot in Moscow involving the purchase of Soviet-built aircraft for use by Nigeria's national flag carrier, and the training of Nigerian technical and flight personnel by Russians in the Soviet Union. No decision has been made but the Nigerian delegation has been quoted as being "fully satisfied" with the results of the discussion.

▶ Aeroflot chief Yevgeni Loginov has promised that a passenger version of the twin-turbine Mi-6 helicopter will be "presented for testing" during the last quarter of 1961. He gave no details on seating configuration, although earlier Russian statements said the Mi-6 would carry about 80 passengers.



AVRO 748

flies into service soon

The Avro 748, powered by two Rolls-Royce Dart engines, has been ordered by leading airline operators in four continents.

HAWKER SIDDELEY AVIATION

32 Duke Street, St. James's, London, S.W.1.

ALPA's Stand Rejected In Southern Dispute

Washington—Civil Aeronautics Board Examiner William Cusick has rejected Air Line Pilots Assn. arguments that Southern Airways engaged in unfair labor practices when it refused to arbitrate issues raised by union pilots who struck the carrier 16 months ago.

Holding that Southern "bargained in good faith with ALPA," Cusick specifically stated that the carrier "was well within its legal rights" when it insisted on retaining the power to punish union pilots found guilty of misconduct during the prolonged strike.

Similarly, Southern's refusal to reinstate the striking ALPA pilots at their former seniority levels—thus affording them higher salaries than pilots hired to break the strike—did not constitute a violation of the Railway Labor Act, the Board examiner said.

ALPA President Clarence N. Sayen promptly announced that his union would appeal the examiner's decision to CAB. Although Southern "appeared" to bargain in good faith, Sayen said, it actually did so in such a way that an agreement could not possibly result. Long established contractual rights supported the union pilot's insistence on retaining their all-important seniority, he contended.

FAA Moves to Develop Pilot Voice Recorder

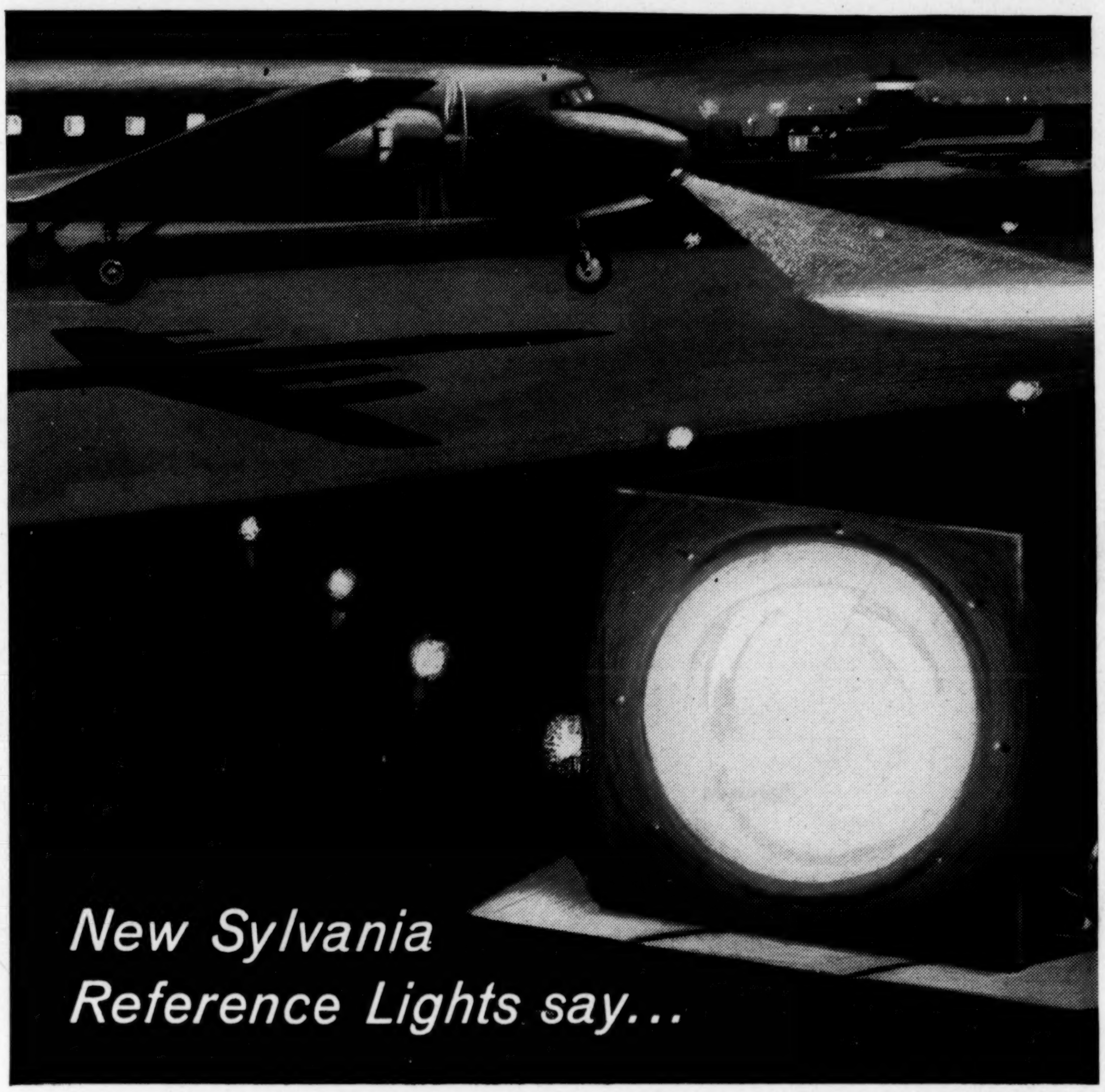
Washington—Federal Aviation Agency has selected United Data Control to develop a cockpit voice recorder that will preserve pilot conversation in heat, water and impact proof containers for analysis after an airline accident.

Although price negotiations still were under way last week, a prototype model of the recorder should be delivered to FAA in about four months. It will record and erase every 30 min.

"Adequate safeguards" will be designed into the equipment to protect pilots from "casual or deliberate snooping," FAA reports.

FAA's Aviation Research and Development Service, in tests earlier this year, found that special noise filters enabled an open microphone to pick up and clearly record cockpit conversation even over maximum engine noise. The recorder, which is to incorporate this filter, will weigh not more than 10.5 lb., exclusive of shielding.

Last month's crash of a Northwest Airlines Lockheed Electra at Chicago, in which the pilot's conversation with the Midway Airport control tower was garbled by other transmissions, apparently led to selection of a development firm (AW Sept. 25, p. 354).



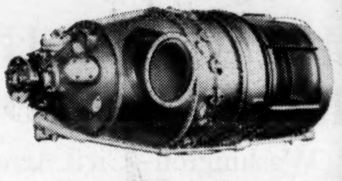
"runway threshold starts right here"... every time

Sylvania high-intensity lights take the guesswork out of spotting thresholds. You're right every time. Landings and approaches are safer and simpler. There's less chance of over- and undershooting the runway. Strobeacon units shoot out short, sharp bursts of high-intensity, white-blue light. Produce a distinct visual outline of runway threshold. Vastly superior to conventional light sources, Strobeacon units have a night range of up to 50 miles, nonglare brilliance; are unmistakable in appearance and a positive landmark to pilots.

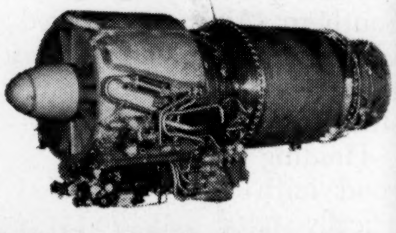
Installation quick, easy, inexpensive! Sylvania's uniquely designed accessories eliminate costly power and control circuit extensions. All wiring is simple, restricted to vicinity of runway threshold. Units are adaptable to large and small airports. May be economically installed on lightweight wooden platforms for extra safety margin. Conforms to applicable FAA and military specifications.

Remember that Sylvania is a leading producer of light systems for airports. So for further information or technical assistance on any airport lighting problem, write to Special Products Division, Sylvania Electric Products Inc., Estes Street, Ipswich, Mass.

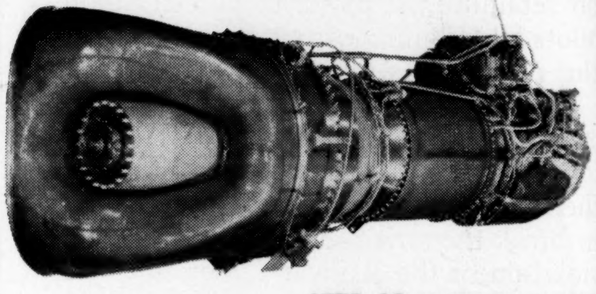
SYLVANIA
SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS
GENERAL SYSTEM



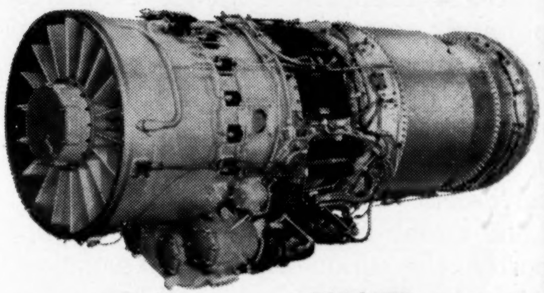
PT6 (500 Shaft HP)



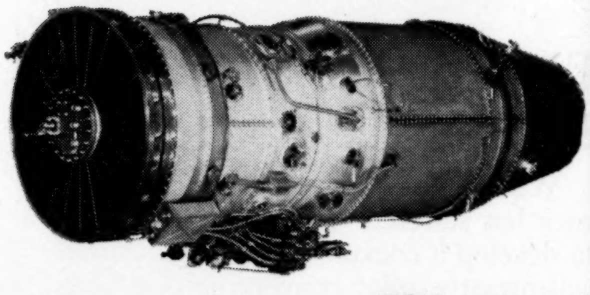
J60/JT12 SERIES (3,000-3,300 Lb.)



JFTD-12 (4,050 Shaft HP)

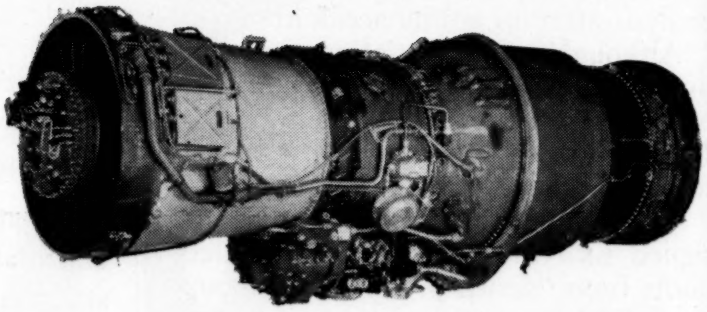


J52/JT8 (8,500 Lb.)

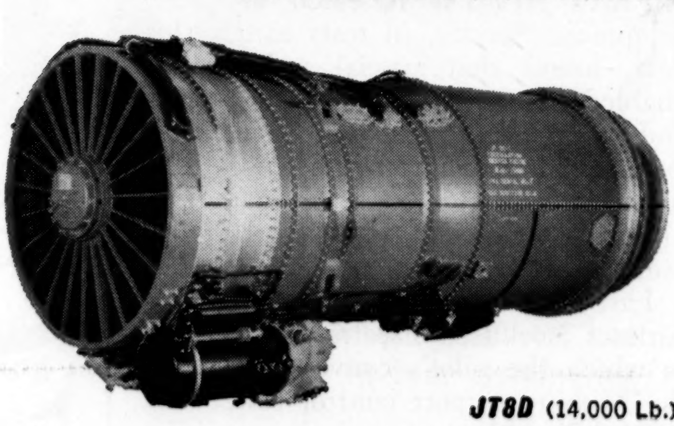


JTF10 (10,000 Lb.)

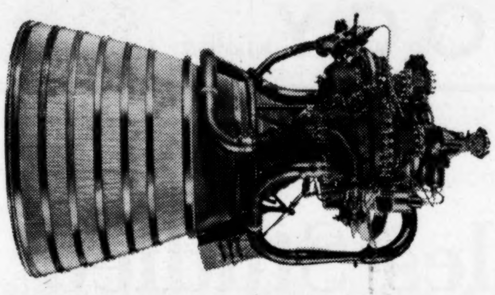
Power



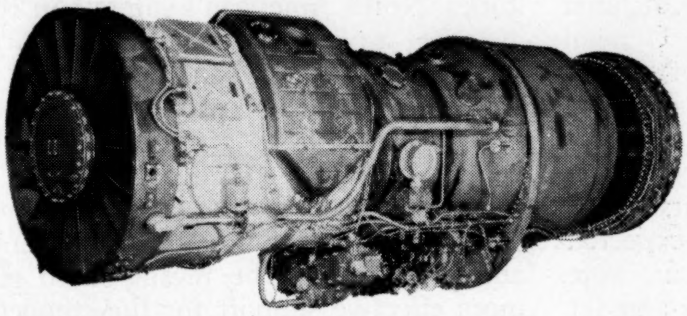
J57/JT3C SERIES (12,000-13,500 Lb.)



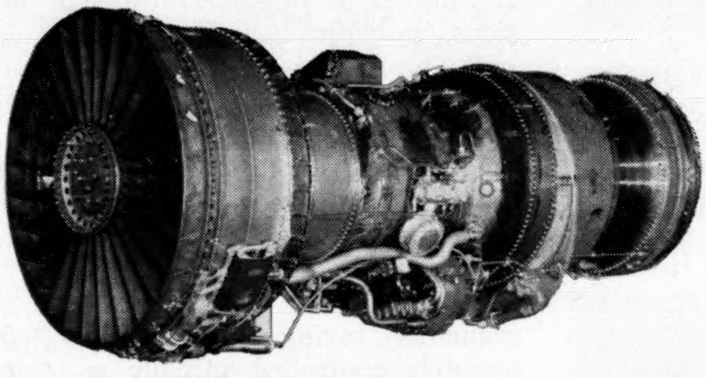
JT8D (14,000 Lb.)



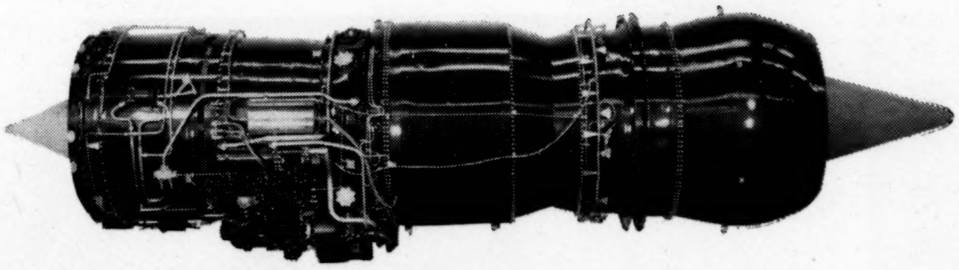
LIQUID HYDROGEN ROCKET ENGINE LR-115 (15,000 Lb.)



J75/JT4A (16,800-17,500 Lb.)



TF33/JT3D SERIES (17,000-18,000 Lb.)



J58/JT11 (30,000 Lb. class)

that spans the field of flight

Above the seven seas and across six continents, Pratt & Whitney Aircraft jet engines have carried more passengers to more places than all others in the world. They power 8 out of 10 long-range Douglas DC-8 and Boeing 707 jetliners — and all the medium-range Boeing 727s on order. They power the majority of our nation's frontline military jet aircraft. These jet engines have proved their dependability and economy in more than 15,000,000 hours of flight. The Pratt & Whitney Aircraft family of engines offers the broadest range of aircraft power available from any single source in the world. Liquid hydrogen rocket engines designed and built by Pratt & Whitney Aircraft will probe deep into space.

PRATT & WHITNEY AIRCRAFT
DEPENDABLE ENGINES

Pratt & Whitney Aircraft DIVISION OF UNITED AIRCRAFT CORPORATION / EAST HARTFORD, CONNECTICUT

U
A

Roving Lunar Vehicles—Part I:

Roving Lunar Surface Vehicles Studied

By Barry Miller

Los Angeles—Roving lunar vehicles which could crawl about the moon's surface gathering scientific and reconnaissance data and supplying logistic support for manned lunar exploration, among their many functions, are being investigated by aerospace companies in anticipation of impending needs for mobile lunar, and eventually planetary, surface spacecraft.

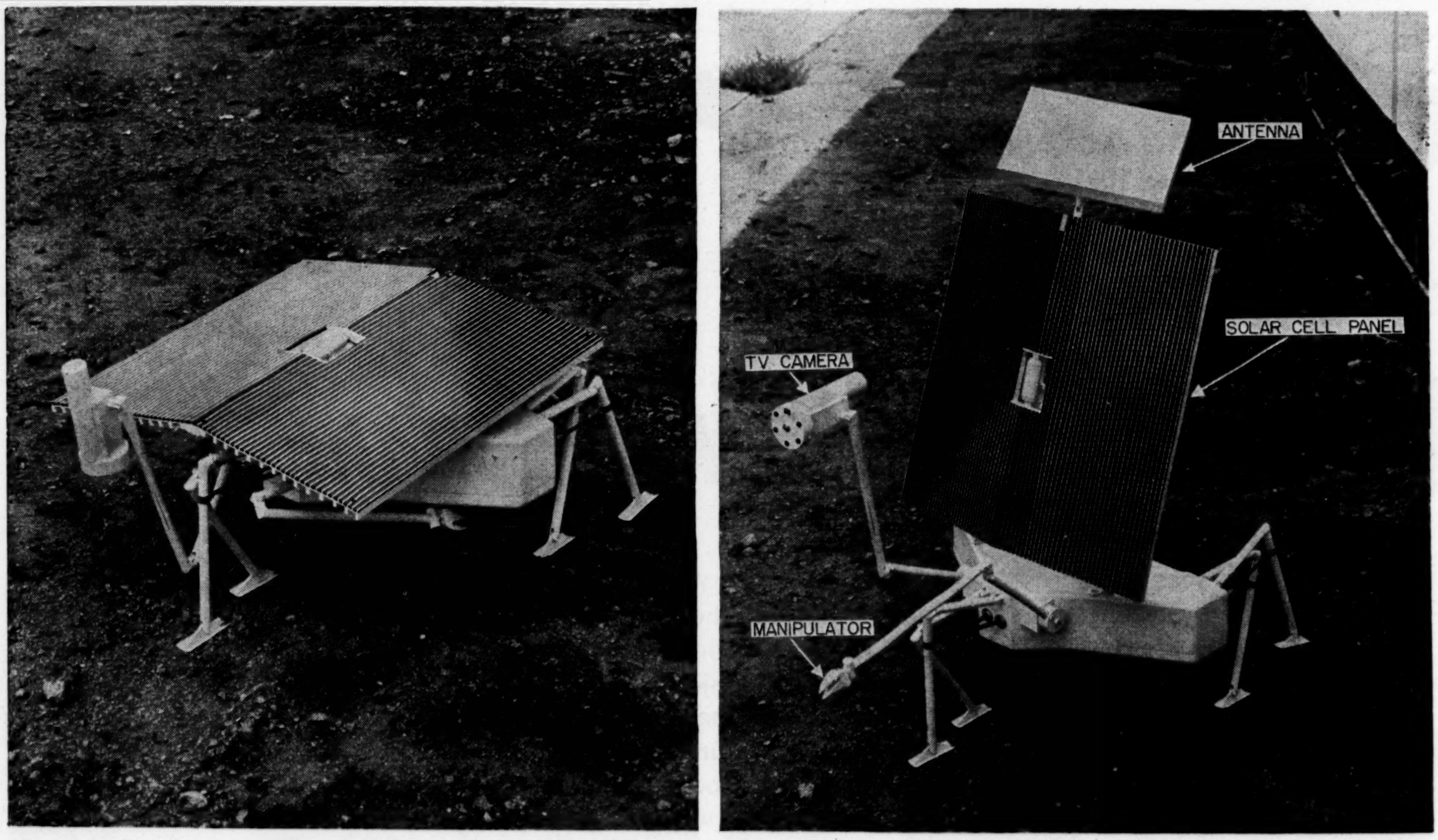
Design concepts for a first generation of roving lunar vehicles are now evolving, largely stimulated by National Aeronautics and Space Administration's projected Prospector program. Prospector envisions a Saturn booster-delivered lunar bus which would be control-landed on the moon's surface. The bus might be capable of moving about or more likely disgorging a mobile vehicle that would reconnoiter the lunar surface, perform scientific experiments, obtain an actual sample of lunar soil and return it to earth. General characteristics of the system—not specific mission requirements or detailed design characteristics—were given to industry over a year ago. But proposal requests and the subsequent award of parallel design studies for Prospector, expected during the current calendar year, were delayed several times by NASA and Jet Propulsion Laboratory, manager of NASA's unmanned lunar and planetary programs.

Surface Travel Interest

The studies of several companies, Boeing, North American Aviation and Martin among them, either predate or are largely unconnected with the anticipated Prospector program. Investigations of mobile lunar surface spacecraft by these three firms were supported in the past by the Air Force, which was examining possibilities of lunar observatories. North American's interest in the practical aspects of lunar surface travel dates from 1958, when it suggested a stationary vehicle with a satellite prowler—as well as a separate mobile vehicle—to NASA's predecessor.

NASA's plans for the Prospector program are undergoing re-evaluation now and probably will be revamped to get more effective support for the stepped-up effort to place a man on the moon. A number of original Prospector missions, possibly including the requirement for the roving lunar vehicle, may be tacked onto the Atlas-Centaur-Surveyor program (unmanned stationary lunar vehicle) or to the early phases of the Apollo (manned lunar vehicle), according to the consensus of industry thinking.

Whatever the outcome of this re-evaluation, roving surface vehicles—both remotely controlled initially and later manually controlled—can be expected



SOLAR-POWERED roving lunar vehicle, capable of being lofted onto the moon by an Atlas-Centaur-Surveyor spacecraft for purpose of reconnoitering lunar surface before heavier mobile lunar vehicles can be landed there, appears as model partially folded (left) and fully expanded (right). The 135-lb. stereo television controlled rover can carry 26 lb. of experimental equipment designed for over two months life, folds into 40 x 40 x 12 in. package, has range limited by life of storage batteries. Solar panel rotates on mount toward sun. Three pairs of legs (right rear pair obscured from view in both photos) with one leg from each pair moving in unison are tentatively planned to provide locomotion at speeds of 2-3 mph. Space-General Corp. recently proposed this rover concept to Jet Propulsion Laboratory. Control would be maintained from Goldstone station in Deep Space Instrumentation Facility.

to perform a multitude of missions in unmanned and manned explorations of the moon and the planets and in military efforts to gain and hold effective control of space. These functions would include:

- **Examining wide areas** of the lunar surface beyond the proximity of a stationary vehicle—analyzing surface and subsurface composition and determining the distribution of various constituents, measuring physical, thermal and electromagnetic properties, locating crevices, caves, ravines, etc.
- **Obtaining detailed information** about the lunar surface from television, radar and infrared sensors.
- **Mapping large areas** of the moon or planetary bodies.
- **Locating and preparing** landing sites for manned lunar landings.
- **Familiarizing a lunar crew** through displays and return samples of what they will encounter on the moon.
- **Aiding in landing** and takeoff from the moon (i.e., by placing an inspecting radio and visual aids at desired points).
- **Assuming much of the burden** of exhausting physical labor for man on the moon.

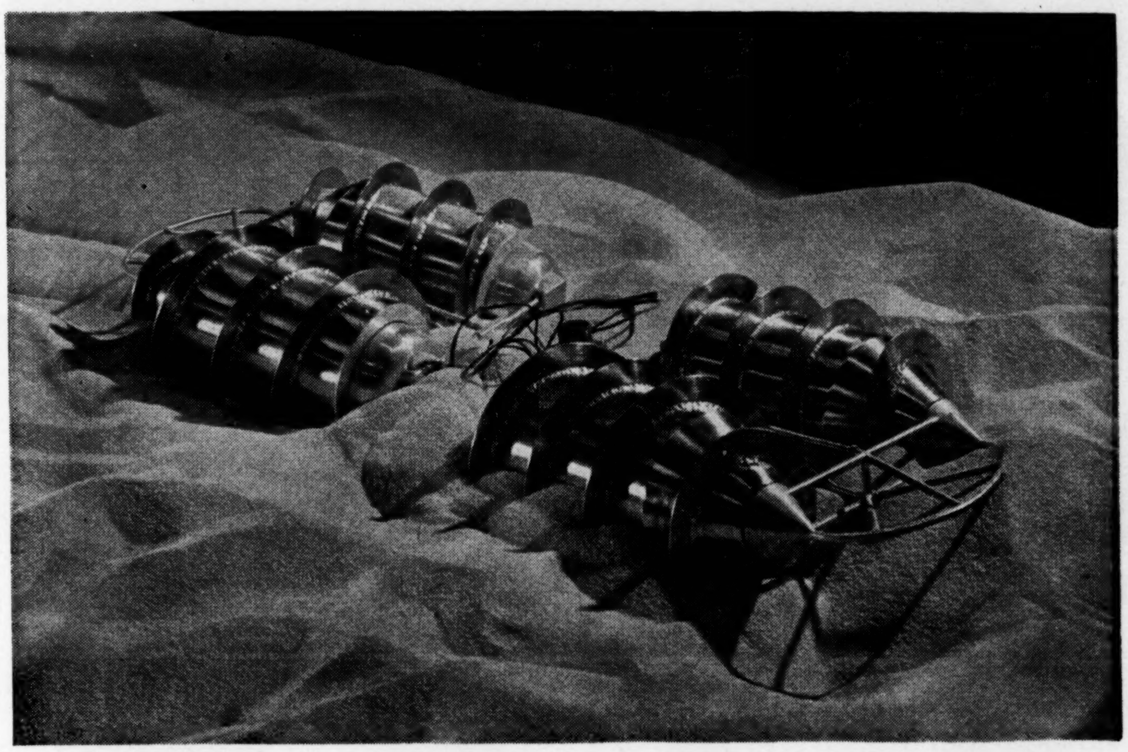
Industry Interest

As space exploration unfolds, industry interest in mobile surface vehicles will grow. It reached a high point several months ago—then slackened with the delays in the Prospector program and the intensive diverting efforts to prepare proposals for manned lunar Apollo vehicle competition.

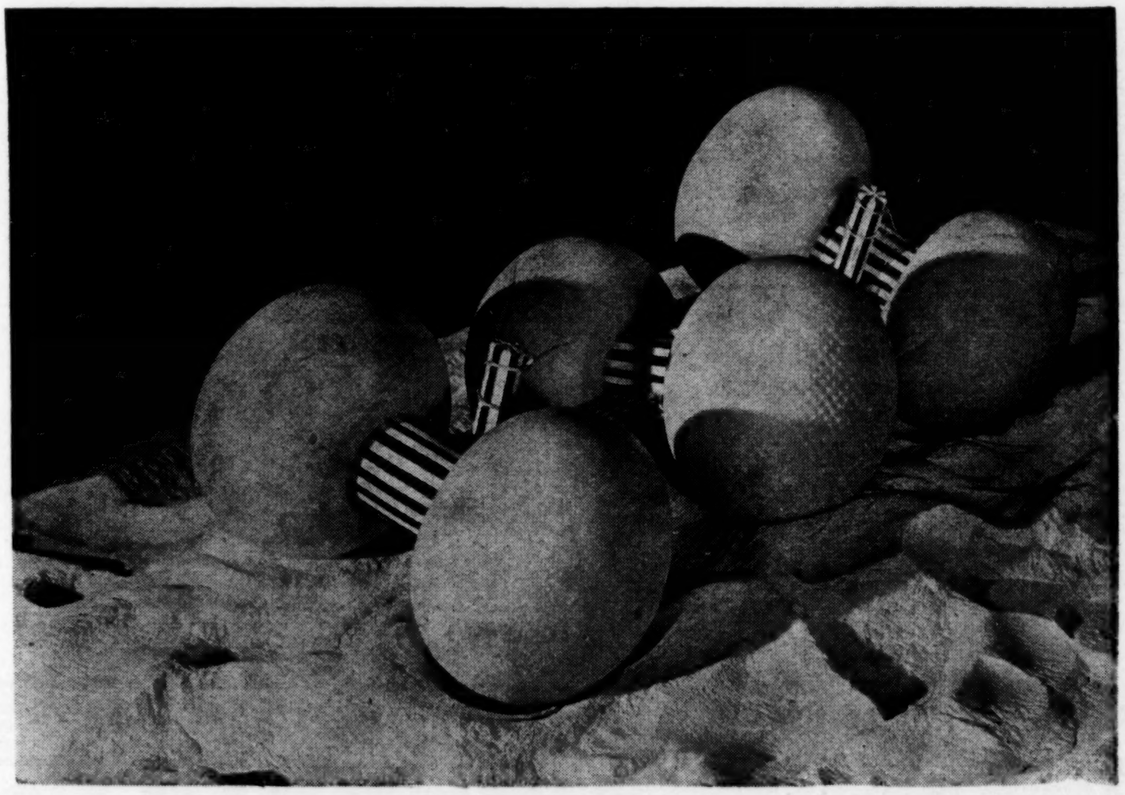
Companies already involved in roving vehicle studies, besides the three mentioned earlier, include Aeronutronic Division of Ford, American Machine and Foundry, General Dynamics/Astronautics, General Electric, General Motors, Grumman Aircraft, Space-General Corp. and Sperry Rand. Others such as Airborne Instruments Laboratory and Hughes Aircraft are primarily concerned with guidance, and control of and communications with roving vehicles. Most of these organizations have submitted unsolicited proposals to JPL and NASA or apprised these agencies of their studies.

Roving lunar vehicle designs are constrained by two primary considerations—the size and nature of the delivery (booster) system and the lunar environment. Close observation of lunar surface texture, petrological analysis, measurement of physical properties, fields, particles, atmospheres and determination of body structure, all to be assembled from data of earlier unmanned Ranger and Surveyor lunar shots, will feed vital data about the moon into the Prospector program.

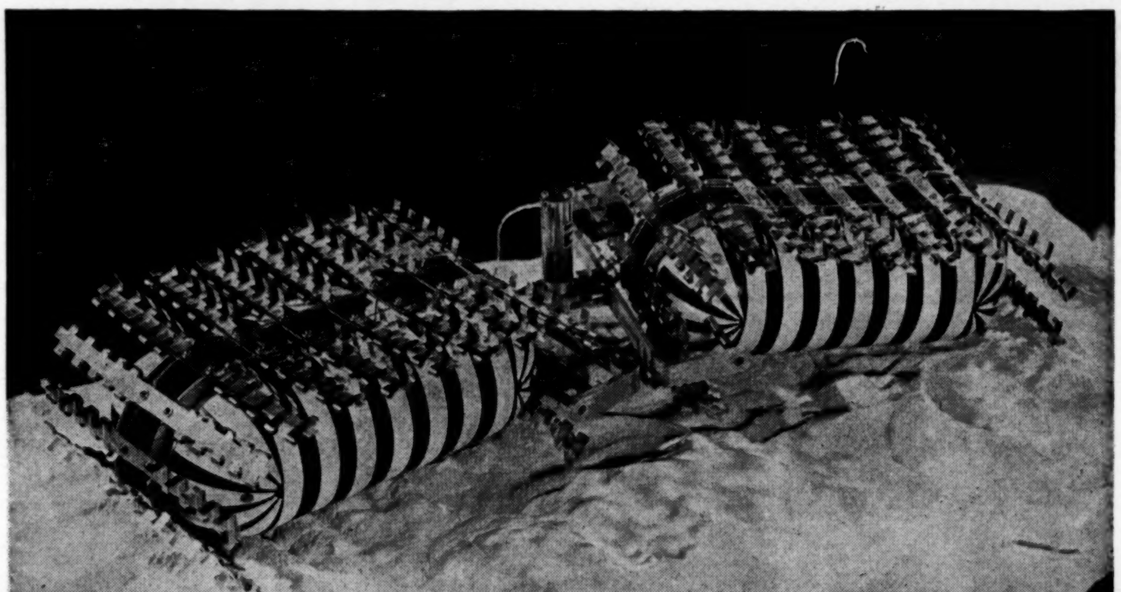
The consensus among those concerned with roving vehicle design is that—with the possible exception of the



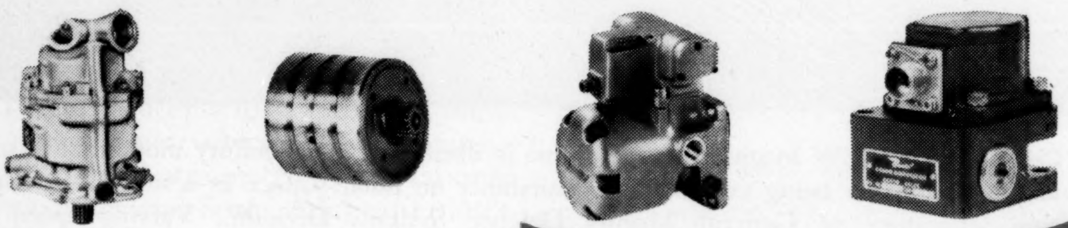
ARCHIMEDES SCREW locomotion technique is illustrated in laboratory model above of a vehicle configuration being evaluated for suitability on lunar surface in a soil bin at Santa Barbara laboratory of General Motors Defense Systems Division. Varying speed of individual screws changes vehicle direction. Large, doughnut-shaped wheels (below) which might be desirable locomotion technique for lunar roving vehicles that must traverse irregular terrain are also under study by General Motors.



TRACK that revolves about the body of model vehicle below is designed to provide locomotion on either soft or hard lunar soil. This is another of three basic means of lunar surface vehicle locomotion that General Motors scientists are investigating.



BENDIX HYDRAULIC PUMPS, MOTORS, SERVO VALVES, ACTUATORS



WHAT'S SO DIFFERENT ABOUT THESE HYDRAULIC COMPONENTS

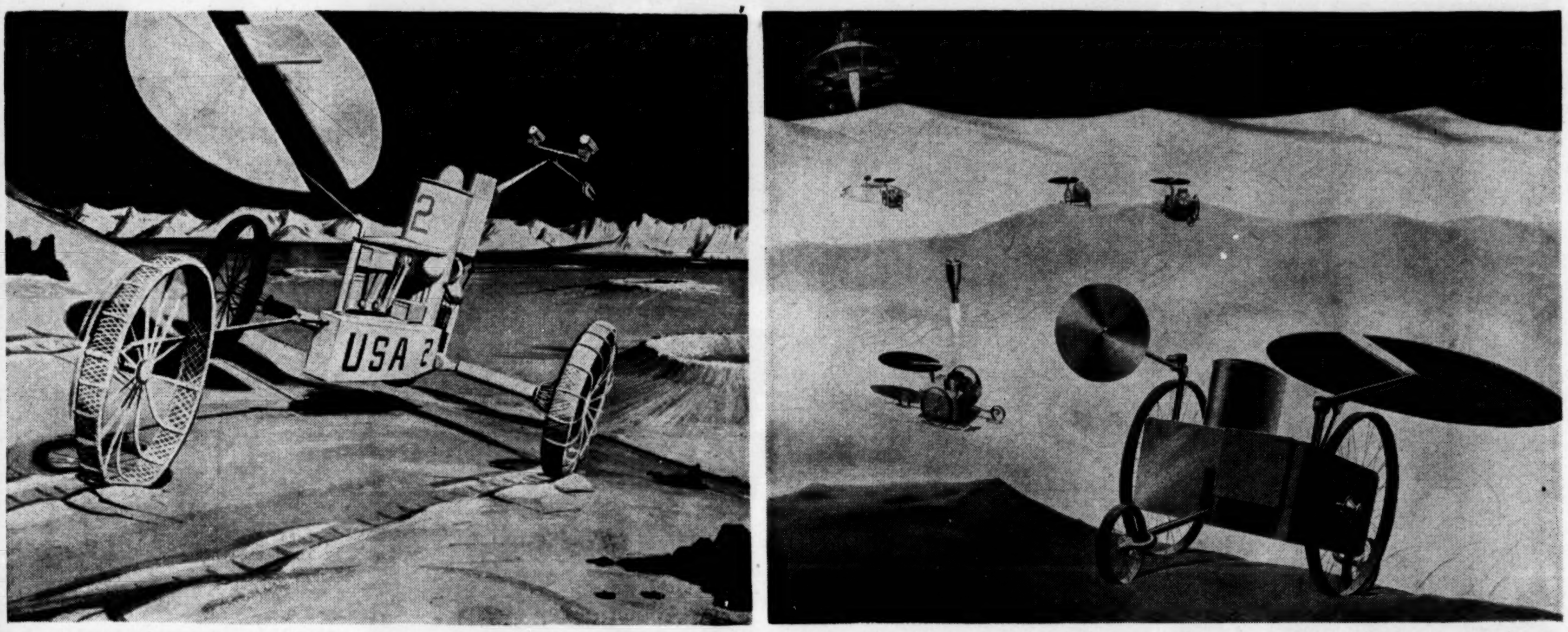
Answer: they're system-oriented. In designing and building hydraulic components, Bendix applies thorough understanding of a complete system's requirements. The result to the Bendix user is pumps, motors, actuators, and servo valves that match system needs exactly—and dependably.

Advanced hydraulic system designs for such diverse applications as missiles, aircraft, industrial, marine, and automotive are available; others are under development. So—whether you need quality components or entire systems—bring your hydraulic requirements to Bendix.

TYPICAL COMPONENT ADVANTAGES: Bendix Hydraulic Pumps, in a wide range of sizes and types, feature: light weight, simple designs with fewer parts, high-temperature capabilities, extra reliability, and over-specification performance.

Bendix PRODUCTS DIVISION South Bend, IND.

THE Bendix CORPORATION



ROVING LUNAR instrument carrier, which would weigh less than a ton and operate from a kilowatt of power obtained from solar cells mounted on two semicircular arrays, could roam moon's surface conducting lunar daytime surveys (left). Radioisotope energy source could provide heat for long lunar nights and for energy conversion system that might provide secondary power. This is one of a family of roving vehicle concepts being studied by North American Aviation's Space and Information Systems Division. Artist's version of Prospector system, as envisioned by General Electric Missile and Space Vehicle Department (right) includes solar-powered rover that could negotiate 20-deg. slopes, 3-ft. boulders and 6-ft. crevices on the moon's surface. Rocket launcher (cylindrical structure in center of vehicle) could fire small rockets containing lunar samples to earth. High-gain parabolic antenna appearing at viewer's left on vehicle in foreground helps maintain command and control link with NASA's Deep Space Instrumentation Facility. Supported flat circular structure is solar panel. Roving vehicle would be soft-landed on moon by Saturn boosted space truck (left background).

means of locomotion—there are no major technological obstacles to successful vehicle design. This is not to suggest there are no major problems in vehicle design and control. There are. Controlling a robot vehicle on the surface of the moon, roughly .25 million miles from the earth poses tough problems. A transmission time delay of three seconds, imposed by this distance, will slow controlled actions of the vehicle. The extreme contrasts of light and darkness on the moon, caused by the absence of an atmosphere, create problems in recognizing objects. The possibility of easily losing a line-of-sight controlled roving vehicle on the moon is ever-present. Yet these are largely regarded as difficult, but soluble, engineering problems.

As for the delivery system, it will restrict both the configuration and moments of inertia of any roving vehicle, engineers at North American point out.

The diameter of the payload nose cone will set maximum limits on the configuration, and the landing dynamics and stability of the delivery system impose limits on moments of inertia.

Although much of rover vehicle attention has centered on problems of lunar vehicle design and control, applicable to varying classes of roving vehicles, three classes of vehicle designs are evolving. They are:

- **Lightweight rovers**—These are small vehicles, capable of accomplishing certain minimal missions, which could be landed on the moon as piggyback vehicles on lunar shots timetabled before Saturn-Prospector or Nova-Apollo spacecraft are ready. Primary value of these lightweight remote-controlled rovers would be to get specific mobile missions accomplished as quickly as possible. As piggyback shots or even as primary payloads for pre-Saturn boosters these must be small.

Typical lightweight rover versions are Space-General's 135-lb. mobile vehicle which is designed to be carried in a folded configuration by a support arm on the side of a Centaur-Surveyor spacecraft. General Dynamics/Astronautics has a similar Centaur-Surveyor version rover and a miniature rover suggested for an advanced Atlas-boosted Ranger shot.

Aeronutronic is also studying two versions of lightweight battery-powered crawlers, one a 50-lb. self-controlled 3-mi. range vehicle that could be rough landed on the moon at 3,000g, the other a 200-lb. locally commanded, 20-mi. range rover.

The time advantage to be gained by these approaches (particularly Centaur-Surveyor) may be dissipating slowly with the estimated nine-month slippage in Centaur's first flight (AW Sept. 4, p. 26).

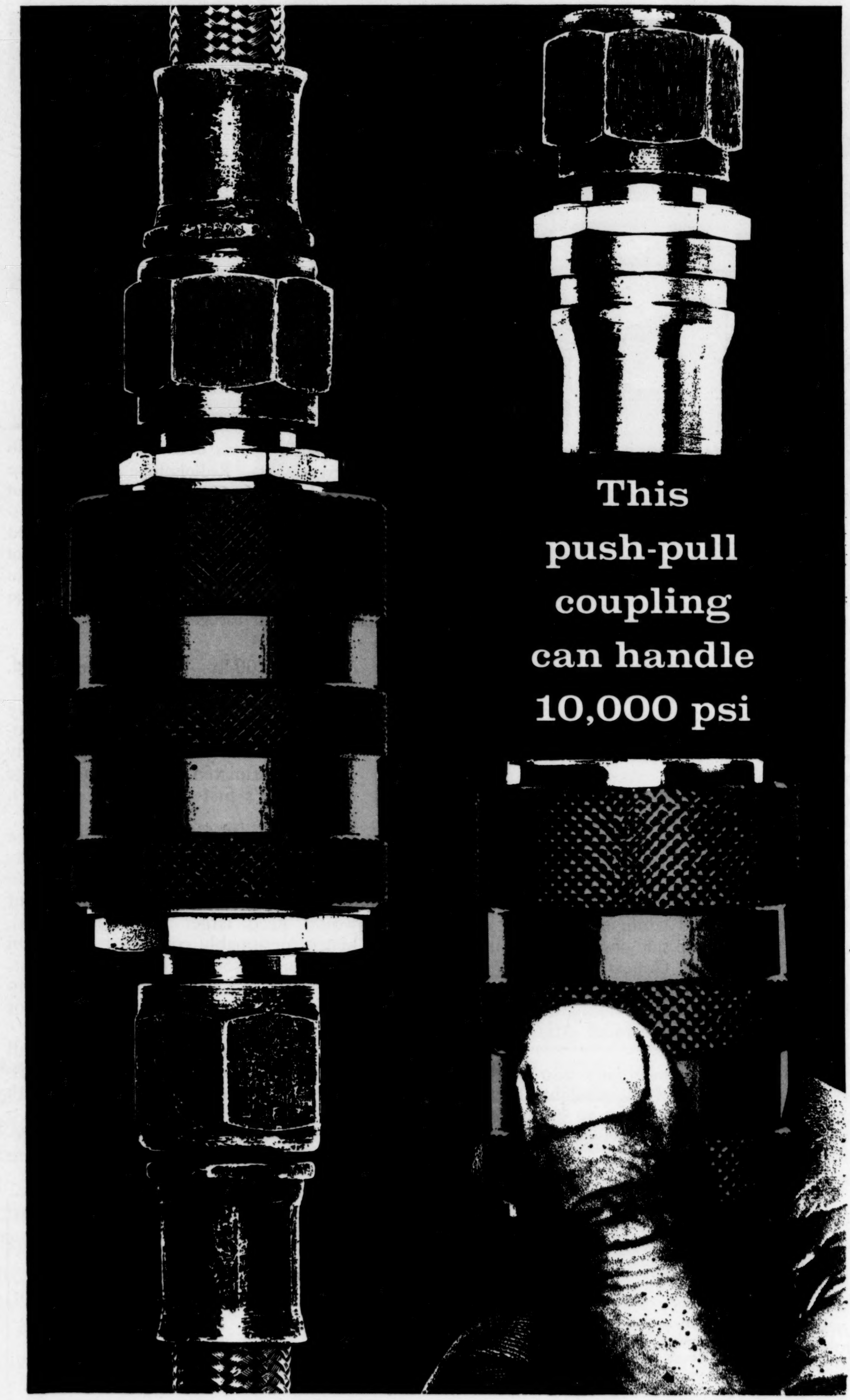
- **"Prospector" rovers**—These would be heavier or larger mobile vehicles roughly 2,000 to 4,000 lb., would have wider capabilities than lightweight rovers, but would need larger boosters (Saturn), hence presumably could not be put on the moon as soon as lightweight rovers. These are not necessarily restricted to Prospector, but the NASA Prospector concept prompted their design.

Perhaps typical of these is a small roving instrument carrier, weighing less than 2,000 lb., conceived by North American and intended for use with a Saturn C-1 launch vehicle. This three-wheel craft, would be powered by a

Percentage of Surface Represented

	Maria			Non-Maria		
Terrain	V	M	D	V	M	D
Very smooth	15	15	85	5	5	60
Smooth	30	30	5	20	20	10
Rough	25	30	5	15	25	10
Very rough	30	15	4	40	40	15
Extremely rough	10	10	1	20	10	5

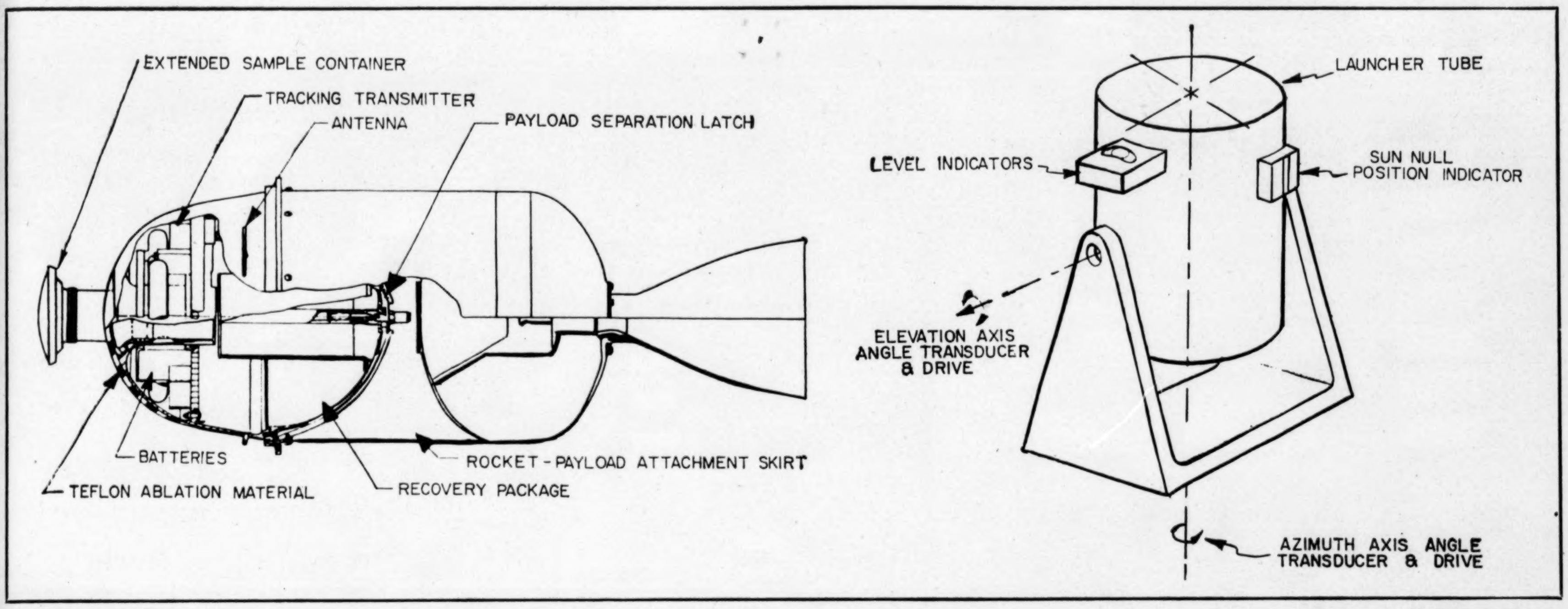
CHART indicates probable percentage of very smooth through extremely rough terrain that would be encountered in marias and other areas on moon's surface according to three hypotheses of their origin: volcanic origin (V), meteoritic impact origin (M), and dust infall predominant (D). Smooth-rough terminology refers to bicycle smooth and rough scheme shown in chart, p. 60. Nature of terrain will be vital constraint of vehicle design.



An easy "push" to connect and "pull" to disconnect is all it takes to operate the new Deutsch high-pressure fluid and gas coupling. No twisting or tricky lock movements are necessary. Here then is an effective design that can be specified for a variety of remote, umbilical, modular, or rack-and-panel applications. Safety at high operating pressures is assured by a color ring that provides visual inspection for positive lock. And both coupling halves exceed all requirements of MIL C-25427 for fluid loss, pressure loss, air inclusion, and physical shock. Temperature range is −200°F to +450°F. To obtain complete technical information on this advanced specification fluid and gas coupling, write today for Data File A-10.

DEUTSCH

HYDRAULIC COMPONENTS DIVISION P. O. Box 73335 • 7000 Avalon Boulevard • Los Angeles 3, Calif.


EXTENDED SAMPLE CONTAINER
TRACKING TRANSMITTER
ANTENNA
PAYLOAD SEPARATION LATCH
BATTERIES
TEFLON ABLATION MATERIAL
RECOVERY PACKAGE
ROCKET - PAYLOAD ATTACHMENT SKIRT
LAUNCHER TUBE
LEVEL INDICATORS
SUN NULL POSITION INDICATOR
ELEVATION AXIS ANGLE TRANSDUCER & DRIVE
AZIMUTH AXIS ANGLE TRANSDUCER & DRIVE

LIGHTWEIGHT return lunar surface sample assembly is designed by Space-General to return 1-lb. sample, provided for it by drill rig on Surveyor spacecraft, to ocean impact area. Assembly consists of an unguided single-stage solid propellant rocket motor weighing 43 lb. which boosts 19-lb. re-entry payload containing sample. Rocket (left) employs a polyurethane ammonium perchlorate propellant having small amount of aluminum. Rocket motor has 0.925 mass fraction and with 45:1 area ratio bell shaped nozzle produces vacuum specific impulse of 296 sec. at design chamber pressure of 300 psia. Rocket launcher for returning rocket with sample from moon is at right.

kilowatt of power supplied by solar panels during the lunar day and would derive a small amount of power for limited use during lunar nights from a radioisotope energy conversion system. Similarly, General Electric's Missile and Space Vehicle Department envisions a rover or mobile laboratory, solar powered and moved by two pairs of wheels within a radius of 250 mi. from the landing site. Sperry Rand has designed a 29-ft. long, 14 ft. wide, 2,000 lb. rover vehicle driven by two large spun wire core metal fabric wheels with a smaller diameter rear auxiliary wheel. All of these vehicle concepts incorporate a rocket launcher containing a return vehicle that could carry lunar samples back to earth.

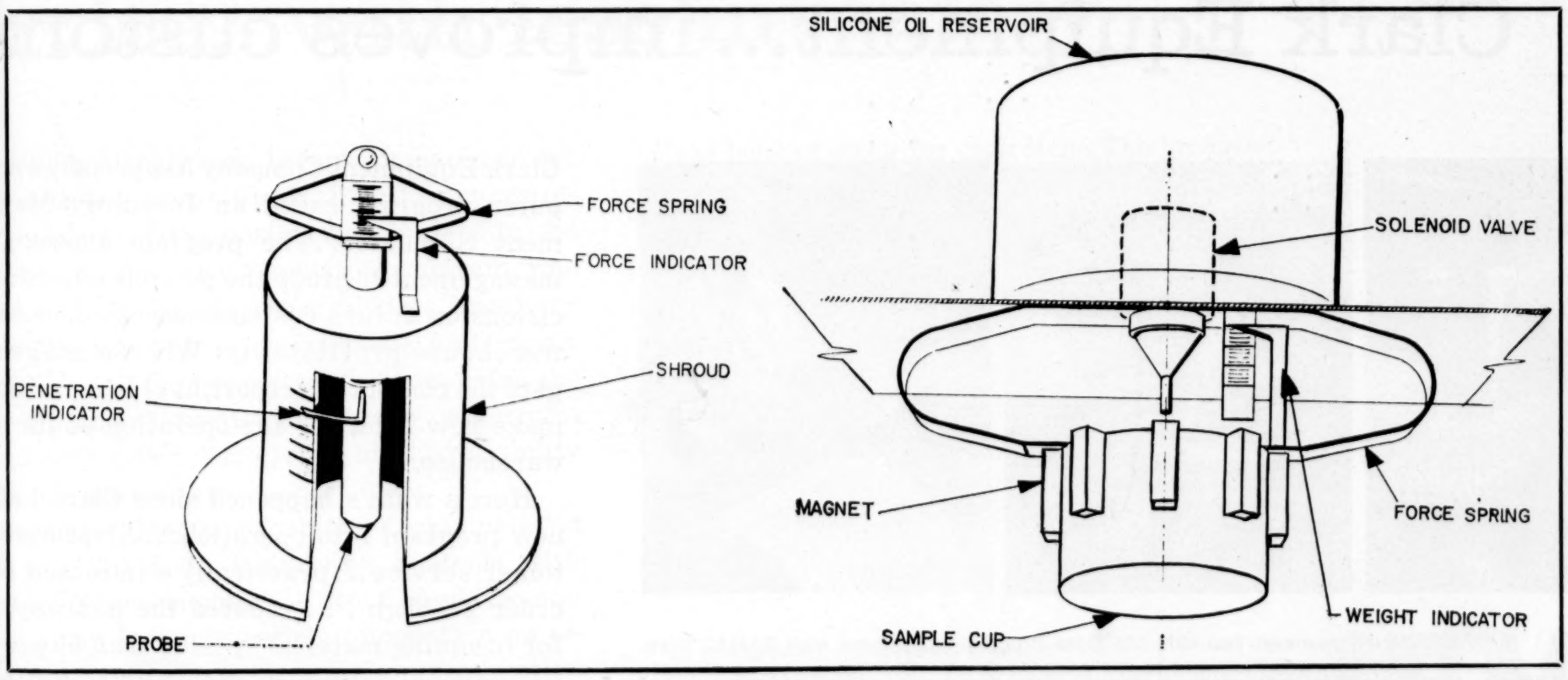
This class of vehicle is most popular because of impending space agency contracts. Others, General Dynamics/Astronautics, General Motors and Aeronutronic among them, are studying it.

Many of these "Prospector" designs of necessity are preliminary because specific design requirements are not yet set. A requirement for night as well as day operation, for example, would impose a heavy burden on the power system and might swing selection of motive power source from one system to another.

- **"Post-Prospector"**—These would include heavier, more expensive, probably later generation lunar rovers which would be intended to satisfy more diverse and complex missions of base support. Such vehicles probably would have provisions for manual control (far easier to satisfy than remote control from the earth) as well as remote control from the lunar base or its control relay stations on the moon.

These designs may overlap Prospector. Actually, some Prospector concepts already include this flexibility, and it may be dictated by the philosophy that all soft-landed equipment should be designed to allow man when he arrives later to make maximum use of it. Sperry Rand's system group, guided by this reasoning, designed its rover large enough and with sufficient controls and lifetime for use by the Apollo team when it arrives.

Space-General's concept of a light-


FORCE SPRING
FORCE INDICATOR
SHROUD
PENETRATION INDICATOR
PROBE
SILICONE OIL RESERVOIR
SOLENOID VALVE
MAGNET
FORCE SPRING
WEIGHT INDICATOR
SAMPLE CUP

EXPERIMENTAL instrumentation which could be used by Space-General's proposed Surveyor roving vehicle includes a force-penetration depth measurement device (left) and a density-void fraction measurement device (right). In former, roving vehicle's arm and manipulator press probe into lunar surface by depressing force spring. A TV camera on vehicle's arm reads depth of penetration from scale on device.

Inventory Management Simulator program at...

Clark Equipment... improves customer

High-capacity memory. Two IBM 305 Data Processing Systems with RAMAC keep track of 75,000 replacement and repair parts in Clark's Chicago parts warehouse. **The computer has the facts.** As soon as shipments arrive at the warehouse, an operator, using this remote inquiry station near the loading platform, finds out from the computers where various items go. **Customer service first.** Using this remote inquiry station in the sales department, the operator gets information from the computer while the customer is on the phone.

Clark Equipment Company has prepared a co
puter program called an Inventory Manag
ment Simulator. The program allows Cla
management to study the possible effects of d
cisions on future customer service and futu
warehouse profitability. When manageme
gets the computer's report, it is in a position
make new rules for the operation of its par
warehouse.

Here's what's happened since Clark put t
new program into operation:...improved cu
tomer service...practically eliminated bac
order problem . . . reduced the putaway ti
for incoming material by more than 50 per ce
. . . reduced emergency order shipping time
50 per cent . . . enabled a physical inventory
be taken without any interruption of servi
to customers.

ervice...with less inventory

Availability highest ever. Inventory management is a complex job at Clark. Its Chicago warehouse is one of the busiest and largest in the country. Before the Simulator program was developed, the warehouse carried an inventory of 85,000 individual replacement and repair parts. Use of the program helped transfer the investment in inventory to those parts most frequently called for, giving high availability with less investment.

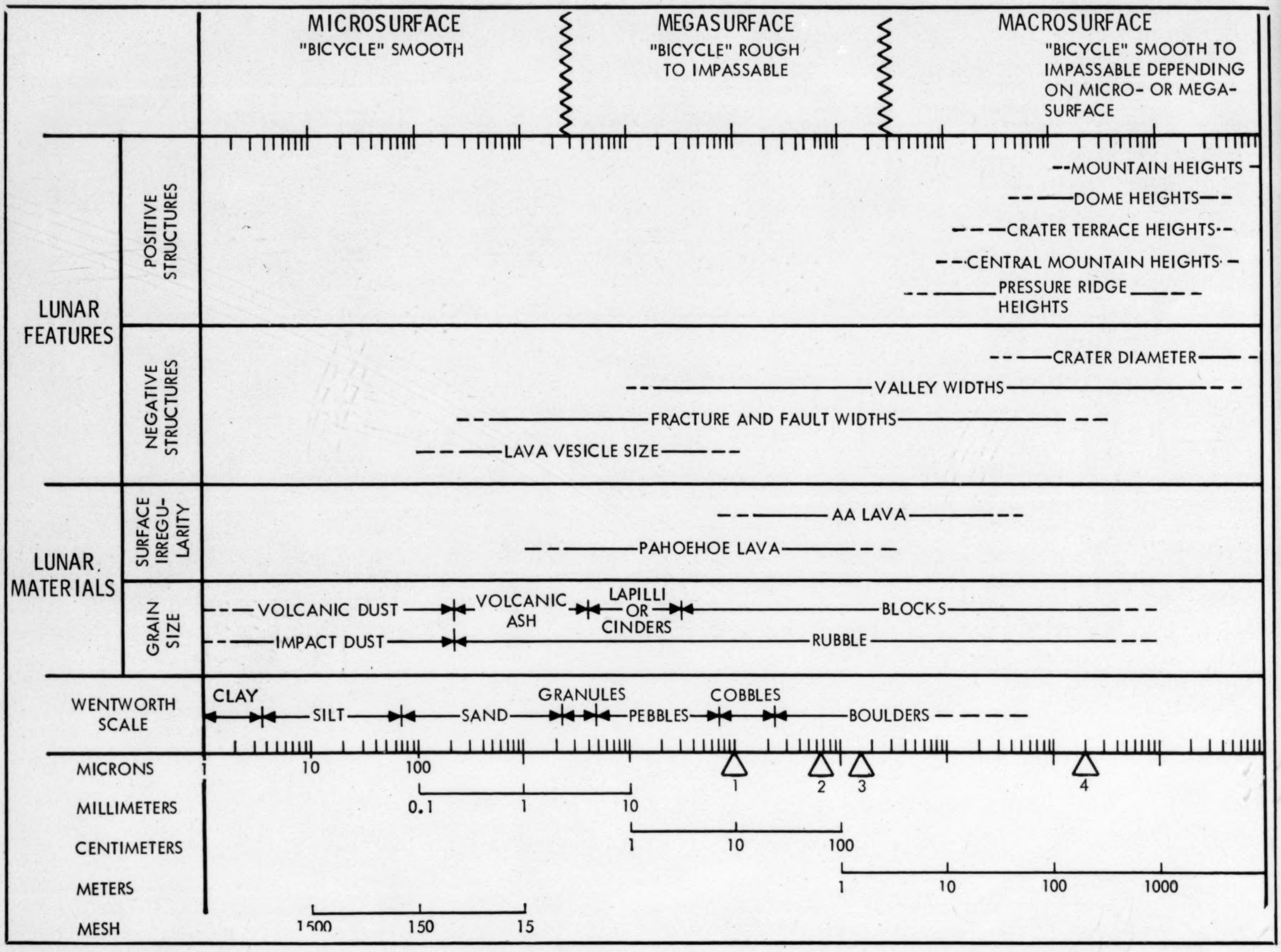
Management Operating System.* Clark installed two IBM 305 Data Processing Systems with RAMAC.® These computers store, update, and offer on an instant's notice information on almost every aspect of the warehouse operation including complete information on every one of the 75,000 items maintained in stock.

Now, Clark is assured of maintaining just the right level of stock for each item. The procurement formulas, developed from the Inventory Management Simulator, even recommend how large a purchase order should be placed for each item and where it should be placed.

If you have an inventory problem, why not consider a simulation program? You don't have to have your own computer. We can supply you with an Inventory Management Simulator...you can rent time on a computer. Result...improve the profitability of your warehouse operation.

A Management Operating System uses **IBM computers to make routine business decisions and take action **automatically** ...flags problems that need management's special attention... frees management to concentrate on the **big problems** and on long range planning. As a result, it gives **tighter control** of **all** business operations...and helps cut costs.*

IBM®
DATA PROCESSING



LUNAR SURFACE is characterized by reference to common terminology of what would be smooth or rough to a bicycle wheel in chart prepared by Dr. Jack Green, Space Sciences Laboratory, North American's Space and Information Systems Division. Metric scales at bottom of chart provide another handy reference. Positive and negative structures refer to protuberances or depressions, respectively, in lunar surface. Term "rough" in radar terminology is reserved for material which scatters isotropically, is a function of wavelength and differs from bicycle terminology, as shown by triangles on micron scale. These indicate 10-cm. wavelength radar signal (triangle 1) which is smooth surface; 170-cm. wavelength (triangle 3) which is rough surface by radar standards. Triangle 4 is limit of telescopic resolution.

weight lunar vehicle for use as a Surveyor passenger, is the result of a company study of what could be done to take an early look at the moon, according to Jack McKenney, associate director of the advanced design group at Space-General. The company's conclusion was that a long-life (greater than two months) high capability vehicle that could cover a great range would be possible with a small collapsible walking vehicle.

The vehicle was designed with arbitrary specifications on the basis of the best estimates of lunar surface conditions. These anticipate that lunar surface is smooth, hard sand, that it has general slopes and is not dotted with many rocks. Purpose of this vehicle would be to confirm and detail these expectations.

The solar-powered roving vehicle weighs 135 lb. and is capable of carrying 26 lb. of experimental equipment at a speed of 2 mph. over the anticipated lunar terrain. It folds into a 40 by 40 in. by 12 in. package for holding on the side of the Surveyor spacecraft.

The vehicle employs a walking technique, achieved with three pairs of legs, one leg of each pair moving simultaneously with the others. One arm holds a television camera for acquiring lunar surface data and for service as an integral part of a control loop. Another arm has a claw or manipulator for selecting and operating scientific instruments. Space-General also is studying a three-wheel version of the same vehicle.

Although the vehicle appears top-heavy in accompanying illustrations of a model (p. 52), its center of gravity is actually in the middle of its body. Above it are a solar cell panel—the primary source of motive power—and a directional antenna with 20 deg. beamwidth. The solar cell panel is oriented continuously in the direction of the sun by a null signal from a crude sun sensor. The solar cell panel mount axis is perpendicular to the plane of rotation of the sun and the solar panel rotates about this axis. Batteries in the vehicle help handle peak loads.

The absence of winds on the lunar surface relieves its designers of fear that the vehicle might be easily torqued over by a strong gust.

Three support latches and a swinging arm assembly are proposed as a means of attaching the roving vehicle to the Surveyor spacecraft. The latches and arm are arranged so that the TV antenna, solar cell panel, TV camera boom, manipulator and legs are held securely when the vehicle is stowed against the side of the Surveyor. An umbilical connector provides limited pre-launch checkout capability by permitting the command receiver, telemetry and TV subsystems to be activated during spacecraft pre-launch checkout on the pad.

The roving vehicle's subsystems are inactive during the spacecraft's trip to the moon. After landing and inspection of the surrounding terrain by the Surveyor TV, the three restraining latches are released by command. The roving vehicle swings away from the side of the Surveyor down to the lunar surface, Space-General explains. This action disconnects an umbilical connector, activating power and enabling roving vehicle legs to extend from a folded position. A second set of latches is actuated when the swinging arm is fully extended, releasing the vehicle a short distance above the lunar surface. The arm then swings back up against the Surveyor.

Once the vehicle is away from the swinging arm a mount which holds the solar cell panel and communications antenna extends. The vehicle moves a short distance from its parent craft, while being monitored by Surveyor television. Once the vehicle is clear of the swinging arm, the vehicle receives commands for independent operation from the Goldstone station of NASA's Deep Space Instrumentation Facility.

The solar panel is commanded to position itself to the proper hour-angle so that it is normal to the sun line. The antenna folds out, and the TV camera is commanded to a desired position. TV communications can then be established with the earth. A binocular vision attachment on camera turret head can be selected, the company says, and the vehicle commanded to move away.

Basically new locomotion techniques could be produced by current roving vehicle studies. A number of locomotion techniques, including wheels, tracks, legs, Archimedes type screws and hover systems are under study.

McKenney says legs appear well suited for a small vehicle intended to operate on the smooth sand surface expected in landing areas on the moon. Spider leg arrangements may also be desired, other industry sources say, where steep or step slopes must be scaled.

Tracks were eliminated from Space-General's rover design because of the absence of surface pressure problems created by muddy surfaces. The mud would create problems in supporting loads, would cause slipping, and make tracks desirable. The weight to surface area of vehicles, which enlarges with the vehicle and might make tracks desirable, becomes a problem only for larger vehicles.

In general, wheels must have radii about twice the size of the height of obstacles they must pass. For a small vehicle that has to be folded for transport, a large wheel size complicates packaging of the vehicle into a small volume.

Walking devices, which Space-General prefers for its lightweight rover on the basis of a preliminary examination, are not looked on as a universal answer to locomotion needs of lunar vehicles, although they appear satisfactory for small vehicles, McKenney says.

The walking device appears to have a number of advantages. These are:

- **High efficiency**—Walking devices can be made with high efficiency. They perform work only in compacting the surface at intervals whereas wheels continually impact the ground, incurring losses. Hence there is low surface compaction loss for legs.
- **Compactness**—Walking systems permit legs and other appendages to be folded easily into compact volume. Studies in progress at Space-General indicate that a similar compact folding arrangement may be possible with wheels, too.

An unusual roving vehicle configuration that combines an Archimedes screw concept and the sled or runner principle is one of three approaches to mobile lunar surface vehicles being evaluated by General Motors Defense Systems Division. The runner of this vehicle is in continuous contact with the soil. Four screws burrow into or across any type of loose soil with steering accomplished by varying the speed of individual screws. Such a vehicle, General Motors says, might be able to progress through loose or fluffy soil even if the vehicle is completely buried.

Models of the screw vehicle, as well as a three-axle vehicle with large wheels suitable for irregular terrain and a track vehicle with the track encircling the body for use on either soft or hard lunar terrain, are undergoing test in the company's land mobility laboratory.

Other types of locomotion pointed out by engineers from American Machine & Foundry Co. in a talk some time ago before the American Rocket Society include steel wire wheels for handling the thermal extremes, low pressure rollers or paddle wheel devices for negotiating soft or extremely fine dust layers.

Each technique appears to have value, depending on size of vehicle, nature and slope of the terrain, vehicle mission, etc. Several locomotion techniques are likely to be studied carefully before the first mobile lunar vehicle inches across the lunar surface.

To provide movement, a tractive force, greater than the resistance to motion, must be developed. This force is limited, however, by cohesive and

Lunar Environment for Roving Vehicles

Designs of roving lunar surface vehicles will be decisively influenced and constrained by the strange, partly unknown lunar environment. Vehicles and their equipment must withstand widely varying temperatures, operate in a vacuum and crawl through as yet uncharted terrain. Unlike the earth, the moon has no atmosphere to protect its surfaces and its visitors from radiation, meteorites, possible solar flares, etc.

On the basis of what is known now or thought to be reasonable assumptions about the moon, Jet Propulsion Laboratory has advised industry on the lunar environment model that it can assume for engineering design studies of the Prospector roving vehicle. This guide may be supplemented or perhaps altered with the knowledge to be gained from lunar shots of the Ranger and Surveyor series.

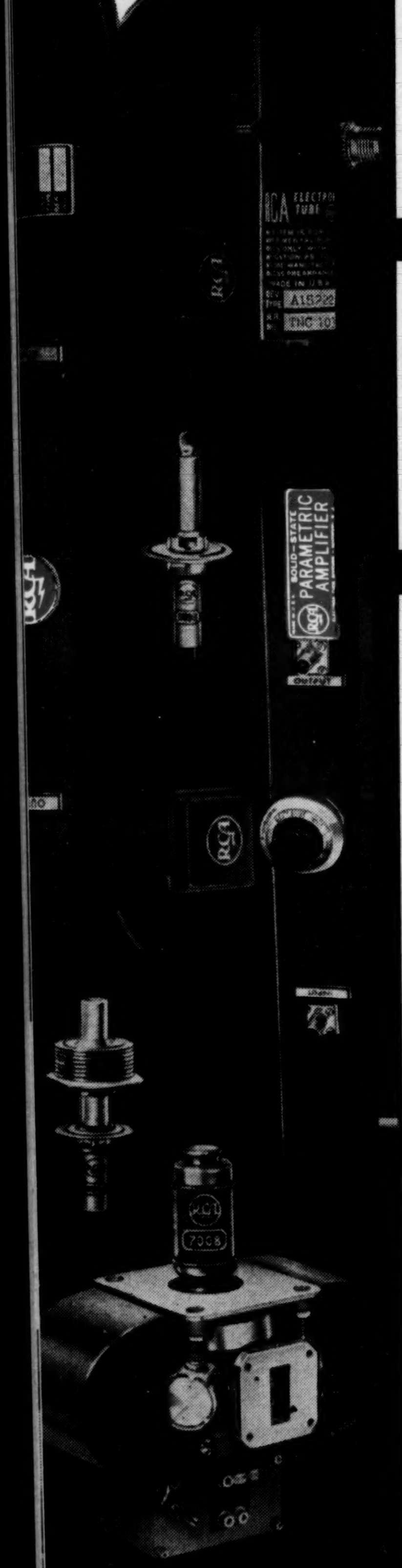
Assumed lunar environmental conditions for Prospector roving vehicle include:

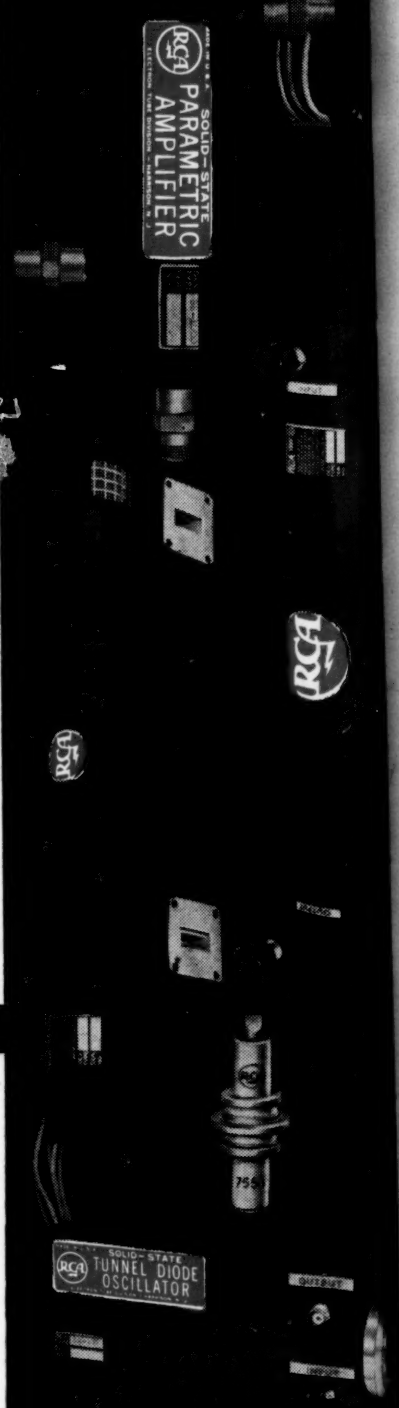
- **Slopes in excess of 15 deg. will not be encountered, but if they are, industry should know probability of spacecraft survival.**
- **Lunar atmosphere is a vacuum.**
- **Protuberances greater than 10 cm. (roughly 4 in.) will not be encountered frequently. When they are, roving vehicles should maneuver around them.**
- **Effects of meteorite particles, magnetic and electric fields, electromagnetic radiation (except the range affecting heat balance) and corpuscular radiation will be small and need not be considered as design conditions.**
- **Extent and distribution of crevices and rills are unknown: the vehicle should avoid these by circumventing maneuvers.**
- **Surface temperature varies from a maximum of about +235F to a night-time temperature of −245F. Temperature deep in the lunar interior is −40F. Reflecting power of the lunar surface is 0.07.**
- **Loose particles, about 0.3 mm. in diameter, containing large amounts of silica, compose the surface layer whose thickness is 1 to 10 cm.**
- **Below the surface layer is a solid material, possibly varying in nature from basaltic type of rock to low-density rock froth, and extending to considerable depths. Roving vehicle designs will assume a minimum crushing strength of 200 psi.**
- **Friction properties of the lunar surface are determined by the surface dust layer.**

Accepted data on the moon is a blend of knowledge gained from classical methods of celestial mechanics and observations of emitted and reflected electromagnetic radiation. The former is the source of information about lunar volume, mass, density and motions. Surface conditions, thermal properties, albedo and atmospheric properties are gained from visual, spectrographic, photometric, radiometric, polarimetric, telescopic and radar measurements.

RCA Microwave Devices

The RCA Microwave facility has recently received the "Reduced Inspection Quality Assurance Plan" award—by U. S. Army Signal Supply Agency—for a number of outstanding tube types. Here are additional types that will be of interest to you.




SOLID-STATE PARAMETRIC AMPLIFIER
SOLID-STATE TUNNEL DIODE OSCILLATOR
RCA

REPRESENTATIVE RCA MICROWAVE TUBES, SOLID-STATE OSCILLATORS AND AMPLIFIERS

LOW-NOISE SOLENOID AND PPM TRAVELING-WAVE TUBES (listed by Power-Frequency Ratings)

Type No.	Frequency Range (Mc)	Min. Power Output (Watts)	Min. Small-Signal Gain (db)	Max. Noise Factor (db)
A-1217*	1100-1400	0.0005	20	4.5
A-1217-V4*	1700-2000	0.0005	25	5
A-1119*	2000-4000	0.001	20	12
A-1207-V5*	2190-2310	0.001	20	4.5
A-1207-V10*	3500-4000	0.001	25	5
A-1139*	1000-2000	0.01	20	12
4019	1000-2000	0.01	28	17
4017	2000-4000	0.01	30	16
4020	4000-7000	0.01	28	18

PPM POWER TYPE TRAVELING-WAVE TUBES (listed by Power-Frequency Ratings)

Type No.	Frequency Range (Mc)	Min. Power Output (Watts)	Min. Small-Signal Gain (db)	Max. Noise Factor (db)
4009	2000-4000	0.01	33	—
A-1140*	8000-12000	0.01	33	—
A-1215*	12000-15000	0.01	30	—
A-1189*	4000-7000	0.1	30	—
4021	1000-2000	1	27	—
4010	2000-4000	1	33	—
A-1205*	4000-7000	1	30	—
4015	8000-12000	1	33	—
A-1225*	12000-15000	1	30	—
A-1093*	1700-2300	15	27	—
A-1160*	2000-4000	10#	25	—
A-1181*	7500-11200	25#	27	—
A-1136*	5000-6000	50#	30	—
A-1179*	2000-4000	80#	23	—
A-1134*	2000-4000	1000#	30	—

PENCIL TUBES (including Integral-Cavity Types)

Type No.	Description	Max. Dimensions (in.)	
		Length	Diam.
A-15131*	CW integral-cavity type for fixed-tuned oscillator service—300 mw useful power output. Variants available to cover 50 Mc intervals, 975-1225 Mc.	4.6**	0.98▲
A-15132*	Similar to A-15131, but for pulsed-oscillator service—500-watts peak useful power output.	4.6**	0.98▲
A-15227*	CW integral-cavity type for fixed-tuned oscillator service—300 mw useful power output. Variants available to cover 100 Mc intervals, 1800-2250 Mc.	2.5**	1.0▲
A-15228*	Similar to A-15227, but for plate-pulsed oscillator service—300 watts peak useful power output.	2.5**	1.0▲
A-15235*	CW integral-cavity type for fixed-tuned oscillator service—50 mw useful power output. Variants available to cover 100 Mc intervals, 3000-3450 Mc.	5.5**	1.0▲
A-15236*	Similar to A-15235, but for plate-pulsed oscillator service—50 watts peak useful power output.	5.5**	1.0▲
7552	For low-noise, Class-A service at altitudes up to 100,000 ft. without pressurization. 13 db min. power gain for 5 Mc Bw.	1.62	0.557
7553	Similar to 7552, but has additional performance and environmental features. 14 db min. power gain for 5 Mc Bw.	1.62	0.557
7554	For low-noise, class-C service at altitudes up to 100,000 ft. (at reduced ratings without pressurization). 1.6 watts power output at 500 Mc.	1.62	0.557
A-15205*	Similar to 7554, but for plate-pulsed oscillator service—250 watts peak useful power output.	1⅝	9/16

Solid-State Oscillators

Type No.	Description
SS-100*	L-Band, mechanically tunable tunnel-diode type
SS-104*	L-Band, electronically-tunable tunnel-diode type
SS-107*	UHF and into S-Band, fixed-tuned tunnel-diode type

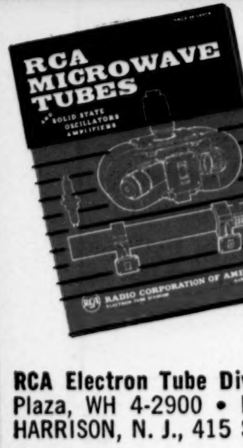
Solid-State Amplifiers

Type No.	Description
SS-500*	L-Band, tunnel-diode type
SS-1000*	S-Band helix-type parametric amplifier
SS-1001-V1*	S-Band helix-type parametric amplifier
SS-1002*	L-Band mechanically tunable low-noise parametric amplifier

Magnetrons (Pulsed-Oscillator Service)

Type No.●	Frequency Range (Mc)	Min. Peak Power Output (kw)	Tuning
6521	5400 ±20	75	None
7008	8500-9600	200	Servo
7111	8500-9600	200	Hand

*Developmental type
**Excludes flexible leads
#Peak
▲Excludes frequency adjustment screws and rf connector
●With integral permanent magnet

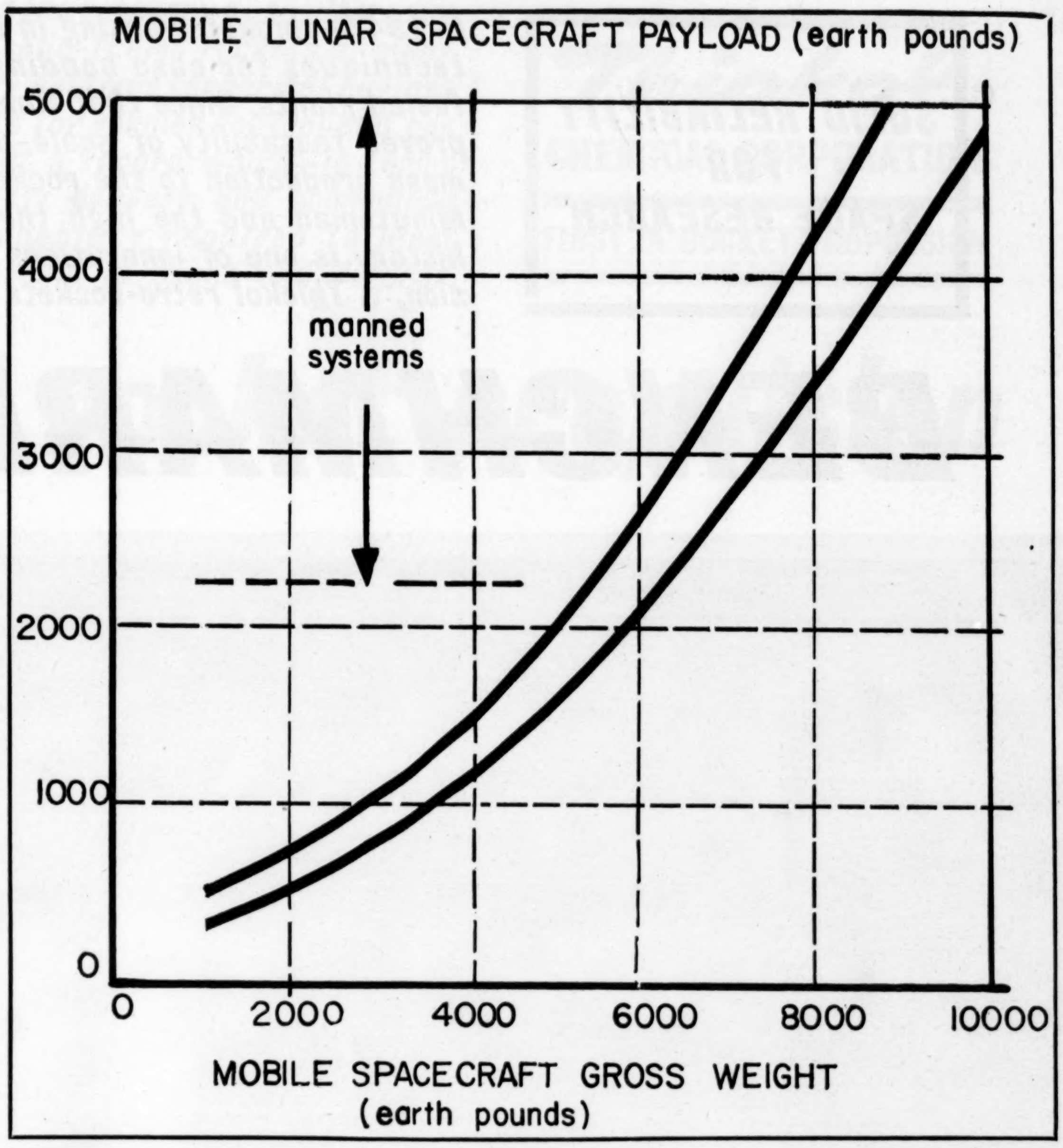

RCA MICROWAVE TUBES
SOLID STATE OSCILLATORS AMPLIFIERS
RCA RADIO CORPORATION OF AMERICA

Now Available! A 16-page booklet filled with technical data on nearly 100 different RCA Microwave Tubes and Solid-State Amplifiers and Oscillators. For your free copy, write on company letterhead to Section J-112-Q, Commercial Engineering, RCA Electron Tube Division, Harrison, N. J.

RCA Electron Tube Division, Harrison, N. J.

The Most Trusted Name in Electronics

RCA Electron Tube Division Field Offices... INDUSTRIAL PRODUCT SALES: NEWARK 2, N. J., 744 Broad St., HU 5-3900 • CHICAGO 54, ILL., Suite 1154, Merchandise Mart Plaza, WH 4-2900 • LOS ANGELES 22, CALIF., 6801 E. Washington Blvd., RA 3-8361 • BURLINGAME, CALIF., 1838 El Camino Real, OX 7-1620 • **GOVERNMENT SALES:** HARRISON, N. J., 415 South Fifth St., HU 5-3900 • DAYTON 2, OHIO, 224 N. Wilkinson St., BA 6-2366 • WASHINGTON 7, D.C., 1725 "K" St., N.W., FE 7-8500.



CHART, prepared by North American Aviation, suggests minimum manned roving lunar vehicle payload would weigh 2,250 lb., require over 5,000 lb. gross spacecraft weight. Design of roving lunar vehicles involves tradeoffs of many parameters and depends heavily on terrain, vacuum surrounding lunar surface and capability of booster, or delivery, system. The two curves represent limits of payload weights.

shear properties of the terrain, North American engineers point out. These properties limit the slope which can be traversed by rolling mechanisms, or navigated by a walking system. But the walking system might climb step-like ridges that would impede rolling devices.

The small lunar gravity (one-sixth that of earth) results in low static loads on the moon, North American notes. A 10,000-lb. rover would weigh only 1,650 lb. Unlike weight, however, the inertia of the roving vehicle will not change when the vehicle is put on the moon. Hence, the dynamic characteristics of starting, accelerating, decelerating and stopping will be significant —particularly in view of the 3-sec. control time lag.

Vehicle Locomotion

Description and operation of Space-General's lightweight roving vehicle illustrates one approach to rover vehicle locomotion. The two outer rear legs move in unison with the right front leg. Each step length is one foot; height of the step is six inches. The legs are composed of upper, essentially horizontal limbs, lower, vertical members and individual feet or base portions hinged in the elevation planes.

The foot motion path minimizes acceleration forces as the three legs rise and advance during each step. Push rods controlling leg motion are arranged so the step length is not changed appreciably if the foot rests on an obstacle and a spring-loaded vertical-motion linkage assures that bumps are traversed in such a way as to disturb the vehicle as little as possible.

A small steering motor can swing the front pair of legs to a desired angle. To avoid skidding of the rear feet during the turning maneuver, the company explains, rear legs are connected by a differential linkage which compensates for the necessary difference in step length or speed between the right and left pairs of rear legs.

Leg Motion Described

Two cams drive all six legs, one producing motion for the six upper members of the legs; a second one producing motion for the six lower members. The three upper members on the first set of three legs are moved 180 deg. out of phase with respect to the upper members on the second set of three legs. The same pattern is repeated with the lower members driven by the second cam.

The cam linkages are spring-loaded to permit stowage with legs in a folded position.

Bearings for the legs and control rod joints, the company suggests, could consist of filled Teflon bushings, flexures and anti-friction bearings that are self-lubricated and hermetically sealed by bellows. This insulates them from damage by lunar dust.

Vehicle legs attach to roving vehicle body structure at corners of a T-shaped truss assembly which supports the major units. A drive motor and gearbox assembly is enclosed in a sealed box maintained at atmospheric pressure to preclude lubrication and heat transfer difficulties. Connections between drive cams and push rods are made through bellows joints making rotating seals unnecessary. The motor operates at an efficiency of 90% by using low resistance windings, vacuum switch commutation and a low operating speed of 500 rpm.

The solar cell panel must be kept pointed at the sun and the antenna at the earth. For this reason, the solar cell panel and antenna assembly are stabilized in elevation angle by arranging them in a pendulum fashion with low natural frequency insensitive to the higher frequency disturbances of vehicle motion.

The angle at which the antenna and solar panel support will hang equals the nominal latitude of the operating site and will be preset before launch. The assembly is connected to the vehicle through a universal joint which permits it to pivot freely in elevation but restrains it in azimuth. When the vehicle turns, an error signal from the sun sensor excites a servo motor which maintains a fixed azimuth orientation relative to space coordinates.

A telecommunications and control system provides this vehicle with terrain and performance observation, transmission to the earth and ground recording of data, and vehicle control.

Operational Limitations

The operational concept for the lunar vehicle permits it to operate only when its solar panels are illuminated by the sun (this occurs during the so-called lunar day which equals about 14 earth days) and it simultaneously is in line-of-sight view of the Goldstone station of NASA's Deep Space Instrumentation Facility. This comes down to eight hours a day operation for a 14 day period followed by inactivity for a 14-day period corresponding to the lunar night. Expected lifetime is about two earth months which would enable it

SOLID RELIABILITY FOR SPACE RESEARCH

In 1947—Thiokol, working in cooperation with JPL, helped develop techniques for case bonding that made possible today's solid fueled giants. Since that time . . . from the RV-A-10 engine which proved feasability of scale-up and the Falcon which introduced mass production to the rocket industry, to the huge booster for Minuteman and the high thrust power of Nike Zeus . . . Thiokol history is one of innovations marking progress in rocket propulsion. □ Thiokol retro-rockets contributed in large measure to the

succe
capsu
perfo
to yie
gener
of re
opera
prese

BENCHMARKS in the s

Thiokol
Thiokol
Thiokol
Thiokol
Thiokol
Thiokol
Thiokol
Thiokol
Thiokol
Thiokol
Thiokol
Thiokol
Thiokol
Thiokol
Thiokol
Thiokol

THIOKOL CHEMICAL CORPORATION □ Bristol, Penna., Rocket Operations Center: Ogden, Utah

velop
solid
which
luced
for
iokol
opul-
the

e

success of the Discoverer Program and the recovery of the Mercury capsule. □ Pioneer in development of solid-fueled rockets of many performance characteristics for many systems (spherical engines to yield high mass ratios, special units for vernier control and gas generators), the Corporation has built a record which—in terms of reliable engine performance, timely delivery and economical operation—reflects the Thiokol capability required to meet present national demands for leadership in space and defense.

Thiokol®
CHEMICAL CORPORATION
FIRST IN ROCKET PROPULSION

science of rocket propulsion

Thiokol
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30

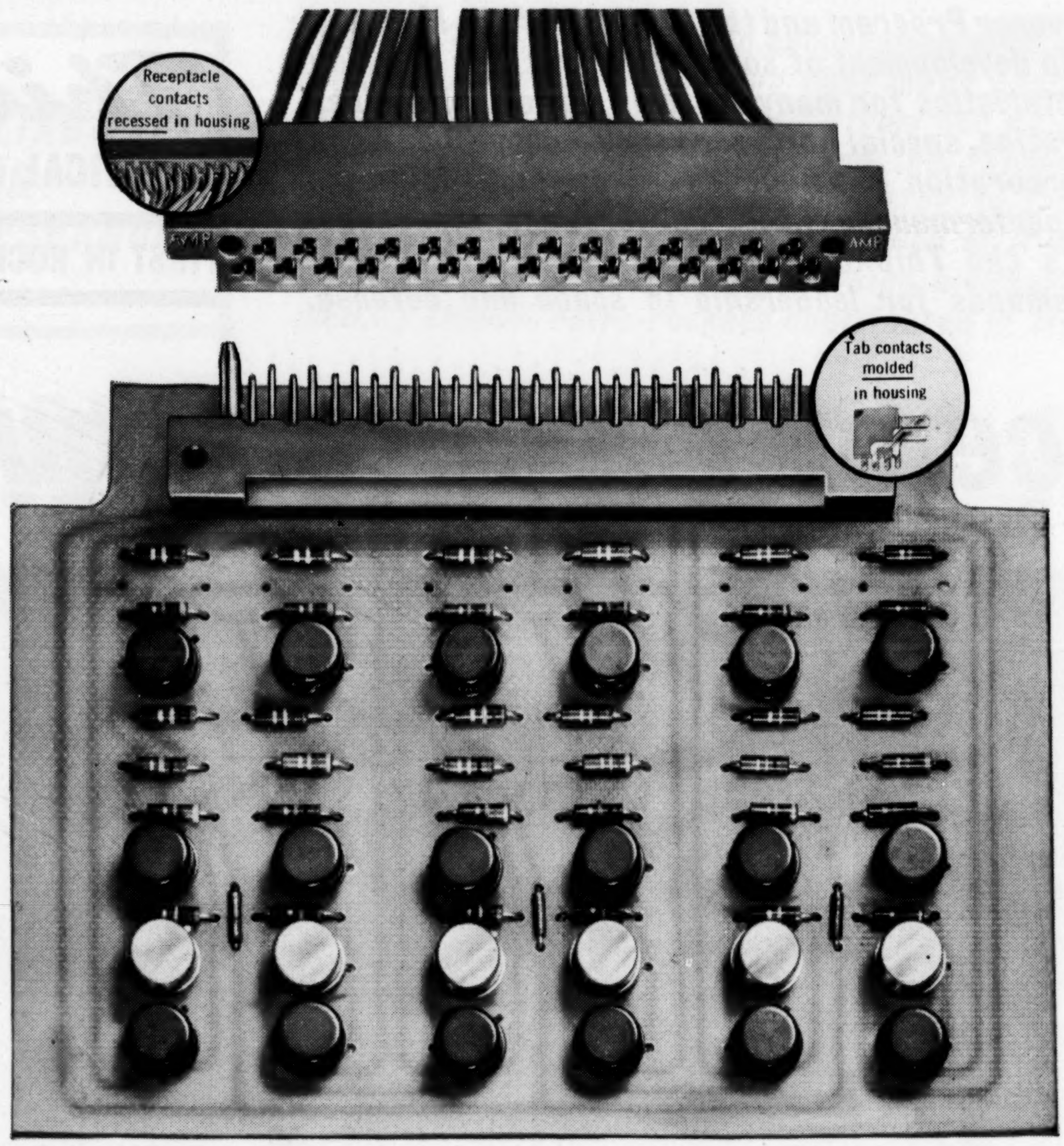
SPECIAL PURPOSE ENGINES FROM THE ELKTON DIVISION

1.	TE-186	Cygnus 40
2.	TE-285-I	
3.	TE-80	Scale Sergeant
4.	TE-146	Cherokee
5.	TE-243	8" Ballistic Test Engine
6.	TE-29	Recruit—Mod. IA
7.	TE-289	Yardbird—Mod. II
8.	TE-289	Yardbird—Mod. I
9.	TE-29	Recruit—Mod. IB
10.	TE-307	Apache—Mod. I
11.	TE-307	Apache—Mod. II
12.	TE-82	Cajun—Mod. III
13.	TE-82	Cajun—Mod. II
14.	TE-82	Cajun—Mod. I
15.	TE-238 A	Blackfoot
16.	TE-184	Cygnus 25
17.	TE-322-1	Swallow Booster
18.	TE-344	Cheyenne
19.	TE-240	Mandan Test Engine
20.	TE-352	Crow
21.	TE-139	
22.	TE-195	Discoverer Retro Mark I
23.	TE-52	Tart
24.	TE-345	Chippewa
25.	TE-280	5" CP Test Engine
26.	TE-316	Mercury Retro
27.	TE-324	Hurler
28.	TE-83	
29.	M-58 A2	Falcon Engine
30.	M-46	Falcon Engine

THIOKOL--pioneer of solid rocket propulsion . . . in all its forms!

Engineers. Scientists. Creativity is always welcome. Perhaps there's a place for you on the Thiokol team. An equal opportunity employer.

ah


Receptacle contacts recessed in housing
Tab contacts molded in housing
AMP
AMP

NO TWIST, TURN OR OFF-CENTER SEATING OF CONTACTS IN THIS CONNECTOR

The AMPin-cert* Blade Connector is staked down for stand pat positioning on the board . . . gives you positive alignment and perfect contact at all times! No board warpage either! The tab housing acts as a rigidizing member . . . keeps the board straight, level and true regardless of environmental conditions and repeated insertions and extractions. These are just two of the answers that AMPin-cert Blade Connectors have for maximum reliability, lowest installed costs and trouble free performance. There are many more, for instance:

- no paid-for but unused contacts with AMP's crimp type, snap-in design
- guaranteed individual contact forces
- large contact areas reduce connector pressures, avoid hard wear on plating and increase contact life
- raised barrier sections and large contact cavities prevent moisture entrapment
- recessed cavity construction eliminates need for sleeving
- rigid metal guide pins assure perfect connector mating during insertion

Complete details will be sent on request.

*Trademark of AMP Incorporated

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

AMP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Italy • Japan • Mexico • West Germany

to operate during at least two of these 14-day stretches.

A stereo television subsystem proposed for Space-General's rover would:

- **Permit safe travel** over lunar terrain.
- **Enable estimates to be made** of width, height and depth of nearby lunar surface objects.
- **Provide visual observation** of experiments while they are in progress.
- **Survey and map** the terrain.
- **Guide use of manipulator** in making repairs.
- **Transmit data** requiring wide bandwidth.

A slow vehicle speed (approximately 2 or 3 mph.), low TV frame rate (1 picture per 3 sec.) and the nearly 3-sec. transmission delay add up to one picture for every nine feet of vehicle motion. This may prove sufficient to properly guide the vehicle.

A command and control subsystem will regulate steering, stop-start, maneuvers, speed, manipulator control, television operation, running of experiments and other physical operations.

A low-power telemetry transmitter will return to the earth data such as temperatures, pressures, vibration, etc., which don't require wide bandwidth or are not suitable for television presentation.

The solar cell panel power system works in conjunction with sealed silver cadmium battery cells to which the solar cells deliver their outputs during portions of the lunar day when vehicle is not on a line of sight with the control center. Batteries store energy for a later use and aid in supplying peak requirements. A power distribution and control panel will regulate power consumption and battery charge operations. Solar cell output is regulated to prevent battery overcharge and to compensate for varied outputs under widely varying temperature conditions on the moon.

Many of the techniques of supplying power now used in space vehicles as well as techniques expected to mature in the future will be applicable to roving lunar vehicles. Lunar environment, North American engineers say, may require modifying heat rejection systems of power devices under development. Power needs may vary from a kilowatt or less in small remote-controlled vehicles to over 10 kw. for large, manned vehicles.

Individual power systems assayed by North American include:

- **Solar energy conversion**—These will limit operation to lunar daylight periods, which may prove satisfactory for remote-controlled, unmanned rovers. Operation of manned vehicles during long lunar nights may be desired, and with high power requirements of large vehicles, solar conversion might not be satisfactory for these missions.
- **Internal combustion engines** and fuel cells—Conversion devices using expendable materials may be useful for large manned surface roving vehicles provided fuel can be resupplied. A hydrogen-oxygen fuel cell would require 2,500 lb. of fuel and equipment to produce 10 hp. for seven earth days. With an average vehicle speed of 2 mph. this would provide an operating radius of 168 mi.
- **Nuclear power**—While small nuclear supplies offer power on an unexpendable basis, shielding men and equipment from radiation and the moon against contamination add problems. Shielding for men and equipment may not be excessive for larger roving vehicles. Three hundred to 400 lb. should be adequate to shield most electronic equipment when the 3-kw. Snap 2 system is employed. Shielding for man might run 1,000 lb. depending on the vehicle configuration.

The 30-kw. Snap 8, North American points out, offers 10 times the power with only a one third increase in weight over the 3-kw. version.

Roving lunar vehicle will be burdened with many scientific experiments ranging from measurement of physical and electromagnetic properties to tests of the effects of lunar environment on biological systems. The larger two of three roving vehicle concepts under study at Aeronutronic are expected to be capable of carrying ecological subsystems. Many companies describe their roving vehicles literally as crawling laboratories.

Typical of experiments Space-General is suggesting for its roving vehicle are a driving force versus a penetration depth measuring device and a device for measuring both density and void fractions of lunar material. The company says its vehicle can obtain much useful information from vehicle performance instrumentation even though it carries only 26 lb. of instruments.

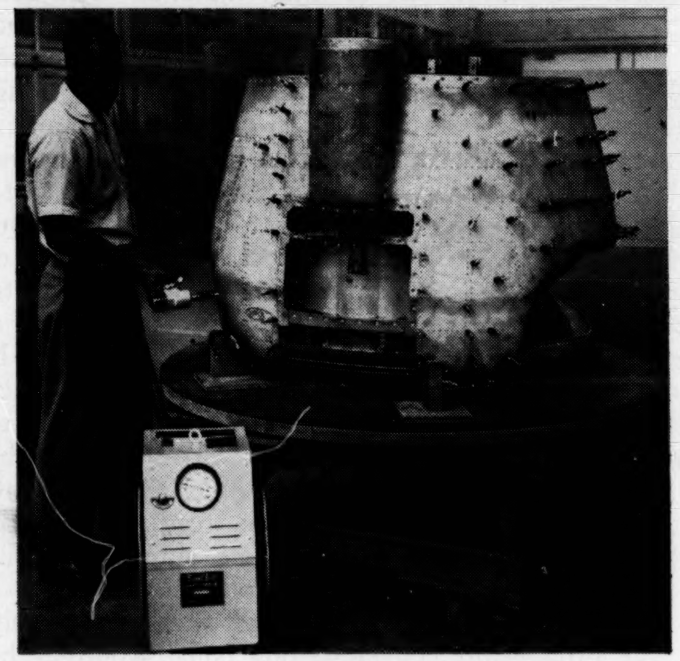
The driving force vs. penetration depth device is similar to a Proctor penetrometer. A cylindrical shroud with flat circular flange rests lightly on the lunar surface. The manipulator presses on a force spring at the top of the device, pressing a probe, guided by the top of the shroud, into the surface. Compression of the spring indicates force required to drive the probe. Depth of penetration of the probe into the surface can be read by the TV camera from a scale showing relative displacement of probe and shroud.

A second device measures density and void fractions (small volumes between particles, such as volumes between grains of sand.) The manipulator scoops up a sample of lunar surface in a cup, scrapes the excess material from the cup by running its top under a horizontal surface of the vehicle. Magnets around the cup's lip hold it against the bottom of two leaf springs.

Gen. Flickinger Receives DSM

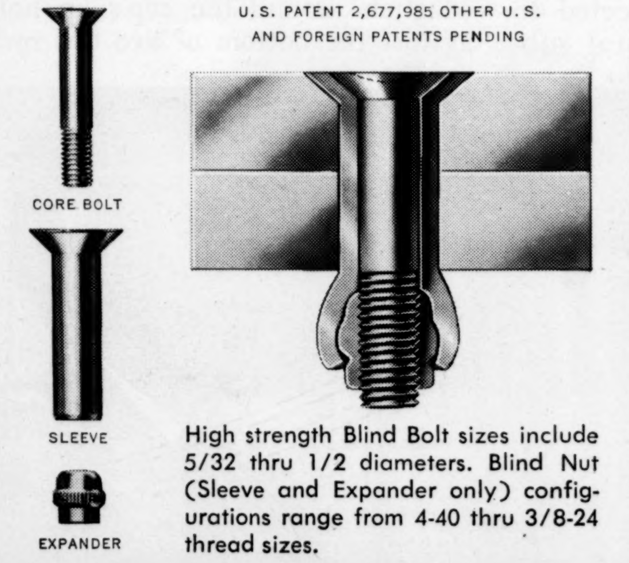
Brig. Gen. Don D. Flickinger, who retired Aug. 31 as assistant for bioastronautics to the commander of Air Force Systems Command after more than 27 years' service, received the Distinguished Service Medal from AFSC Commander Gen. Bernard A. Schriever for "exceptionally meritorious service" as commander of the European office of the Air Research and Development Command and bioastronautics assistant to Schriever in the 1956-1961 period. "Early in this period," the citation said, "Gen. Flickinger foresaw the need for manned space flight in the immediate future." Gen. Flickinger has become a bioastronautics consultant in Washington, D. C.

SONIC VIBRATION PROBLEMS ON DC-8 SOLVED BY BLIND BOLTS



Above photo shows portable electric-hydraulic Power Unit (3000 psi max.... 110 v. source) actuating hand held Gun to drive 1200 Blind Bolts in each Ejector and Thrust Brake. Air-Hydraulic Power Units are safely used in flight ramp areas for repairs on fueled aircraft. Hand installation tools are also available.

U. S. PATENT 2,677,985 OTHER U. S. AND FOREIGN PATENTS PENDING



High strength Blind Bolt sizes include 5/32 thru 1/2 diameters. Blind Nut (Sleeve and Expander only) configurations range from 4-40 thru 3/8-24 thread sizes.

Blind Bolts were finally selected by Douglas DC-8 engineers for use in the Sound Suppressors. Exhaustive tests of various blind fasteners determined that Blind Bolts in temperature areas could best resist overall sound pressure levels reaching 150 decibels!

In this unusual application, the remarkable ability to the Blind Bolt to resist sonic vibrations stems from several of its inherent design features...the *twin locking technique,* combining the oval lock of the Expander to grip the thread of the Core Bolt and the wedge lock between the Expander and Sleeve end...*the hole filling ability,* resulting from the expansion of the Sleeve shank during the installation pull-up of the Expander into the Sleeve end...and lastly, *the excellent fatigue resistance,* gained from the high tensile preload imposed by the Core Bolt and from the cushioning effect of composite fastener materials.

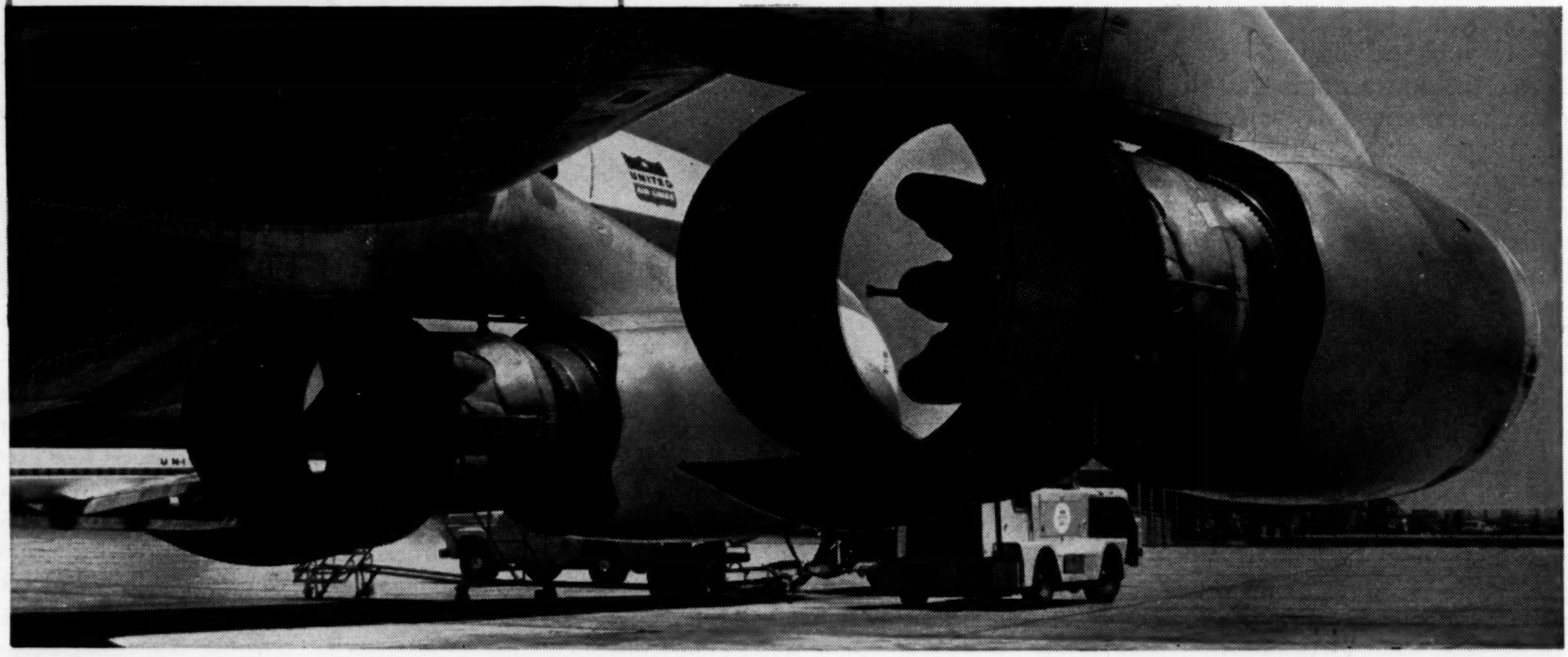
Because the coefficient of expansion must remain the same to prevent loss of fastener preload, the compatability of structural materials at high temperatures is essential. Inside the stainless steel Ejector where exhaust gases reach 900°F., A-286 stainless steel Blind Bolts are used. On the outside where structural temperatures reach 300°F., Type 431 stainless steel Blind Bolts are used.

From the shop viewpoint, Blind Bolts are installed rapidly and quietly. Hole preparation is simple, no reaming is required. Only Blind Bolts offer a choice of gun driving tools designed for repairs or modifications in difficult or tightly congested structural areas.

If sonic vibration is your fastener problem...consider Blind Bolts. Write for brochure.

hi-shear CORPORATION

2600 WEST 247th STREET, TORRANCE • CALIFORNIA



The manipulator is released and weight determined. Since the cup is full, the volume is known. Then silicone oil is poured into the cup and volume of oil determined. From this, density and void can be determined.

An important function, related to roving lunar vehicles, will be the task of obtaining and then returning a lunar sample to earth. Several concepts picture this as an integral part of the roving vehicles' duties. Roving vehicles as conceived by General Electric, Sperry Rand and North American, for example, would contain single rocket launchers and single small individual rockets capable of sending small payloads back to earth.

Space-General has proposed to JPL a special lightweight rocket system which could be attached to the Surveyor spacecraft and weigh 130 lb., less than the instrument payload capacity of Surveyor. The rocket is designed to return lunar samples obtained for it by the drill rig of Surveyor.

The entire system would consist of a return rocket, fired on command from Goldstone, a launcher, apparatus for measuring and culling the lunar sample and a programmer and telemetry system.

The return rocket would be a single-stage solid propellant vehicle weighing slightly over 60 lb. Its 43-lb. motor would boost a 19-lb. re-entry payload nose cone to an initial velocity of 9,000 fps. Suggested propellant would be polyurethane ammonium perchlorate containing a small amount of aluminum. The motor would have a mass fraction of 0.925 and could produce a specific impulse of 296 sec. (at design chamber pressure of 300 psia.) with a 45:1 area ratio bell-shaped nozzle.

The payload is divided into three chambers. One aft facing chamber will accept the lunar sample; a second contains recovery aids such as sea-marker aluminum power, shark repellent, flotation/antenna balloon, and a lighter-than-air corner reflector balloon. The main chamber will contain power supply, S-band tracking and search transmitters, balloon inflation gas storage container and other electronic and electromechanical gear.

The rocket is carried to the moon within a launcher attached to Surveyor. The launching sequence as well as the measuring, transport and loading of the sample into the nose cone chamber are controlled by a programmer, command receiver and telemetry transmitter all weighing about 5 lb. and consuming about 6 watts.

Rocket launching will be commanded by Goldstone.

Other interesting features of roving lunar vehicles under study by industry include:

- **Sperry Rand**—The 2,000-lb. roving vehicle is designed to evaluate prospective Apollo landing sites, to perform terrain sampling and analysis and to be used by follow-up Apollo crew. It is powered by a combination of solar cells and batteries, requires 1,200 watts, can travel at 2.5 mph., and is guided by earth-based operators through TV cameras. It would carry a sample drilling system and would carry an ion chamber among its laboratory equipment.
- **Aeronutronic**—Three vehicles under study at Aeronutronic differ basically in the manner of intended control. The 50-lb. crawler, which has calculated life of 10 hr. and requires 500 watt-hr. of energy, would have self-contained control system. A larger, 200-lb. crawler could be commanded locally, presumably from a mother craft, such as a Surveyor. Its expected lifetime is 100 hr. and 10 kilowatt-hr. of energy are required. Both of these lightweight crawlers are battery operated. The largest of the three Aeronutronic vehicles, a 1,000-lb. craft, would be controlled from the earth, powered by what the company describes as a proprietary Ford development, have an expected life of 500 hr. and an energy requirement of 1,000 kilowatt-hr. Its range would be 100 mi.
- **General Electric**—This company's rover, or Mobile L laboratory, designed as part of a Prospector scheme, will be capable of negotiating slopes of 20 deg., 3-ft. boulders and 6-ft. crevices. It can carry several interchangeable payloads. Special insulation materials were devised that will enable it to operate in temperature extremes from +150C to −150C.

This is the first portion of a two-part article on roving lunar vehicles. The second part, dealing with roving lunar vehicle control and communications, will appear in the next issue of AVIATION WEEK.

Satellite Propulsion Pulse Rocket Tested

Continuous operation for 46 min. has been announced for a 25-lb.-thrust radiation-cooled bipropellant pulse rocket tested by the Marquardt Corp.

Applicable to current satellite propulsion requirements, this type of rocket engine has repeatedly demonstrated a space specific impulse of 310 sec., using a fuel of hydrazine and nitrogen tetroxide. Damage to the engine at the end of the test run was negligible, Marquardt says.

Pulse frequencies up to 100 cycles per sec. in engines from 0.2 to 100 lb. thrust have been demonstrated with effective pulse widths as low as .003 sec. Combined response and delay times of .006 sec. now are available and will be reduced to .001.

PROBLEMATICAL RECREATIONS **86**

How many primes are in the following infinite series where the digits are arranged in declining order? 9; 98; 987; 9876; ....; 987654321; 9876543219; 98765432198;... etc. *—Contributed*

Of prime importance to our Data Systems Division are systems engineers who can integrate developmental sub-systems into a smoothly functioning digital tactical data system. Tell us about yourself if you're in Chicago at the 17th Annual National Electronics Conference, Oct. 9-11, by calling Bob Baker at ANdover 3-3131. If you don't plan to attend, write: Mr. Harry Laur.

ANSWER TO LAST WEEK'S PROBLEM: **It should take the hands $\frac{12}{11}$ hour to come together, not 65 minutes or $\frac{13}{11}$ hour as it actually does. Therefore, Dr. Reed's watch runs too fast by a factor of $(12/11 \div 13/11) = \frac{144}{143}$. In one hour it gains 60 [(144/143) − 1] or 60/143 minutes.**

An Equal Opportunity Employer

LITTON SYSTEMS, INC.
Data Systems Division
Canoga Park, California

Gamble on Tiros Satellites Is Paying Off

By Edward H. Kolcum

Washington—Tiros cloud cover satellite series, started 18 months ago as a research and development gamble, is showing daily during the 1961 hurricane season the first tangible economic return for the U. S. investment in space exploration.

Meteorological scientists did not know what the Tiros program would bring when the first satellite was launched Apr. 1, 1960. Test objectives for Tiros I centered around three scientific questions:

- **Can a satellite** transmit high quality television pictures to the earth?
- **Would these pictures** contain useful weather data?
- **Could the pictures** be analyzed and transmitted to users fast enough to be used for operational forecasting?

After three Tiros launches, all three questions have been convincingly answered "yes," and a global forecasting network has become an immediate possibility.

Meteorologists have long known that the higher altitude from which you can observe, the more accurate are your observations. The weather science progressed to satellites through use of balloons and rockets mainly to observe clouds and large-scale cloud formations, because clouds are the signatures of weather events.

Earliest reference to satellites as observation platforms for clouds came in a Rand Corp. report, written in 1951 for the Air Force by Stanley M. Greenfield and William W. Kellogg. Two years earlier, USAF Col. (then Maj.) D. L. Crowson had proposed use of rocket-borne cameras to take cloud cover pictures.

Dr. Harry Wexler, director of research for the Weather Bureau, went a step further in 1954 by suggesting that weather satellites contain television cameras, infrared and albedo sensors and radar. In 1957, Dr. William K. Widger and C. N. Touart of the USAF Geophysics Research Directorate defined the infrared system which led to the sensors used in Tiros. Dr. Widger has since transferred to the National Aeronautics and Space Administration.

Precise instrumentation for the Tiros satellites was decided upon in 1958 by a panel of the Advanced Research Projects Agency, under the chairmanship of Roger Warner.

The weather satellite program went to NASA when the civilian space organization was formed in 1958, and Radio Corp. of America's Astro-Electronics Division was awarded the contract to develop the Tiros satellite and its instrumentation.

Very quickly after the launch of Tiros I, meteorologists learned from the pictures it returned that clouds are organized into extremely large-scale patterns which sometimes are more than 1,000 mi. in diameter. Cloud organization had been evident from aircraft, rocket and radar observations, but before Tiros, it was thought to be true only on a small scale.

Probably the most dramatic contribution of the Tiros series came Sept. 10, when Tiros III discovered Hurricane Esther before the conventional radars or search aircraft spotted the storm. Meteorologists estimate that the storm was located two days earlier than it would have been had not Tiros been in orbit. This potentially disastrous tropical storm veered away from the U. S. coastline Sept. 21-22, but perhaps never before has the country been better forewarned of a hurricane.

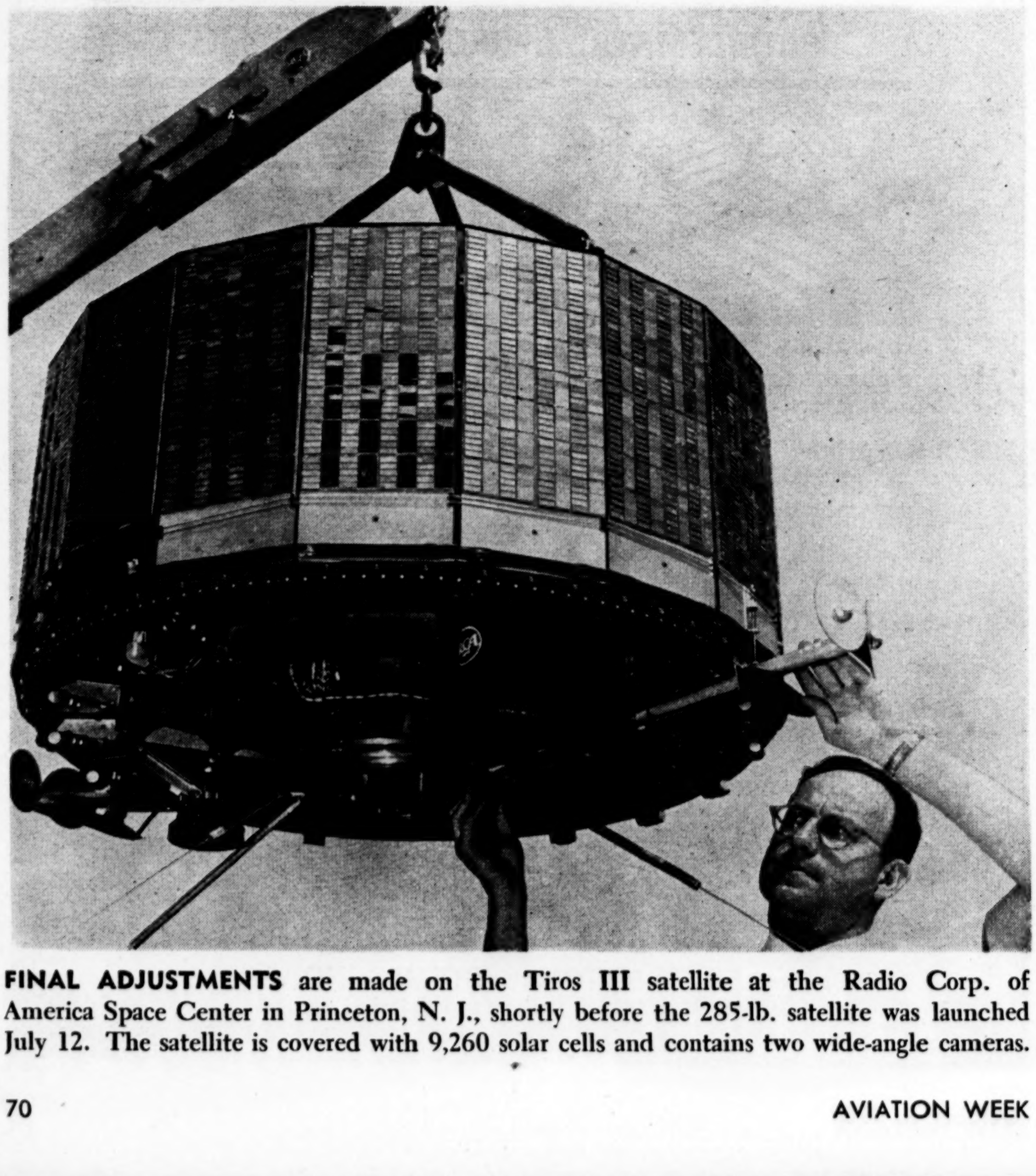
Tiros III was launched July 12 to coincide with the hurricane season, but it was not expected to locate storms. The objective was research—comparison of satellite data with storm information from conventional sources so that meteorologists could assess both findings.

The convincing successes of all three Tiros satellites have prompted the Weather Bureau to push hard for a national weather satellite system, both spacecraft and ground stations, which could become operational late next year with the launch of the second-generation Nimbus I satellite. A detailed plan for a national meteorological satellite system has been developed by the Panel on Operational Meteorological Satellites, calling for an annual expenditure of about $60 million which could effectively make long-range weather forecasting a more exact science.

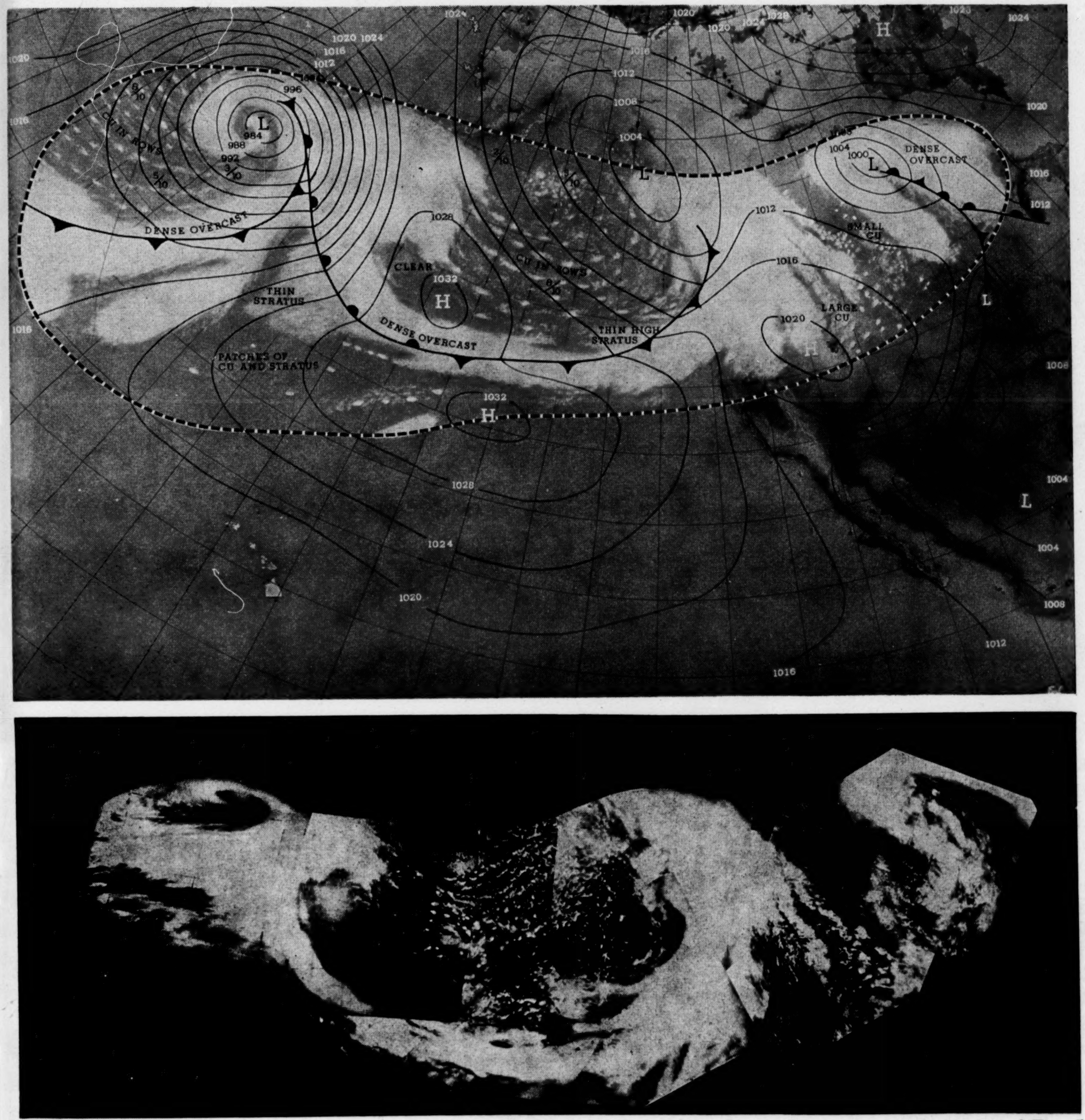
Meanwhile, research to refine systems, to gain longer operational reliability from electronic components, and to provide operational experience for meteorologists will continue with the Tiros program. Four more Tiros satellites will be launched in order to keep one weather satellite continuously aloft until the Nimbus series gets under way.

The Tiros system includes an orbiting satellite, two ground readout stations with a backup station, and a data analysis center. Readout stations, operated by RCA, are located at Wallops Island, Va., and Point Mugu, Calif. RCA's Space Center in Princeton, N. J., is the backup station. Data analysis center is in Suitland, Md.

Each of the three Tiros satellites in



FINAL ADJUSTMENTS are made on the Tiros III satellite at the Radio Corp. of America Space Center in Princeton, N. J., shortly before the 285-lb. satellite was launched July 12. The satellite is covered with 9,260 solar cells and contains two wide-angle cameras.



CLOUD COVER photographs serve weather forecasters by making available accurate data for very large scale analyses. Mosaic of Tiros I pictures (bottom) has been superimposed on a weather map (top) showing conditions for the Western U. S. and the Pacific Ocean. This research map was made of conditions which existed May 20, 1960.

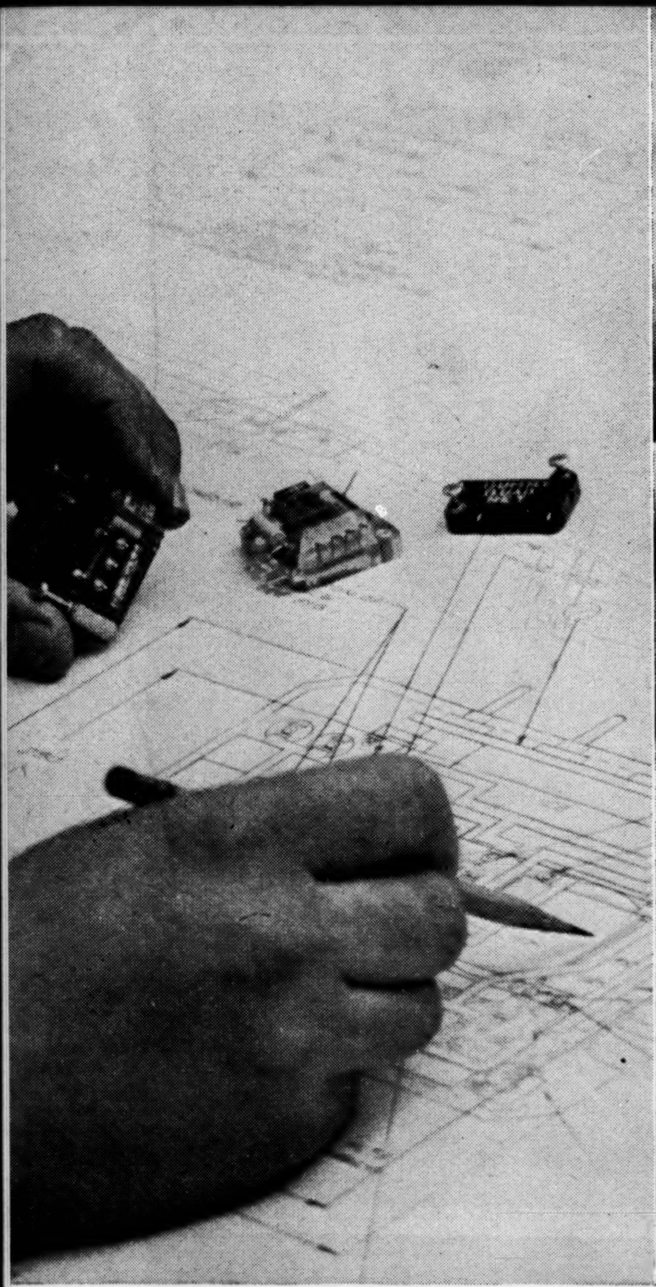
orbit differs slightly in its instrumentation. Major features of the three satellites are:

- **Tiros I:** transmitted 22,952 video pictures from its launch date Apr. 1, 1960, until the end of its useful life on June 14, 1960 after 1,302 orbits. Approximately 14,000 photographs were useful. Pictures were taken by identical videcon scanner cameras, each with its own magnetic tape storage unit able to store 32 photographs on each orbit. One camera had a wide angle lens with a vertical coverage area of 800 sq. mi., and the other a narrow angle lens covering 80 sq. mi. Wide angle lens had a three-mile resolution, and the narrow lens, 0.3 mi. Shutter speed for both cameras was 1.5 milliseconds, and the scanner "painted" 500 lines per frame.

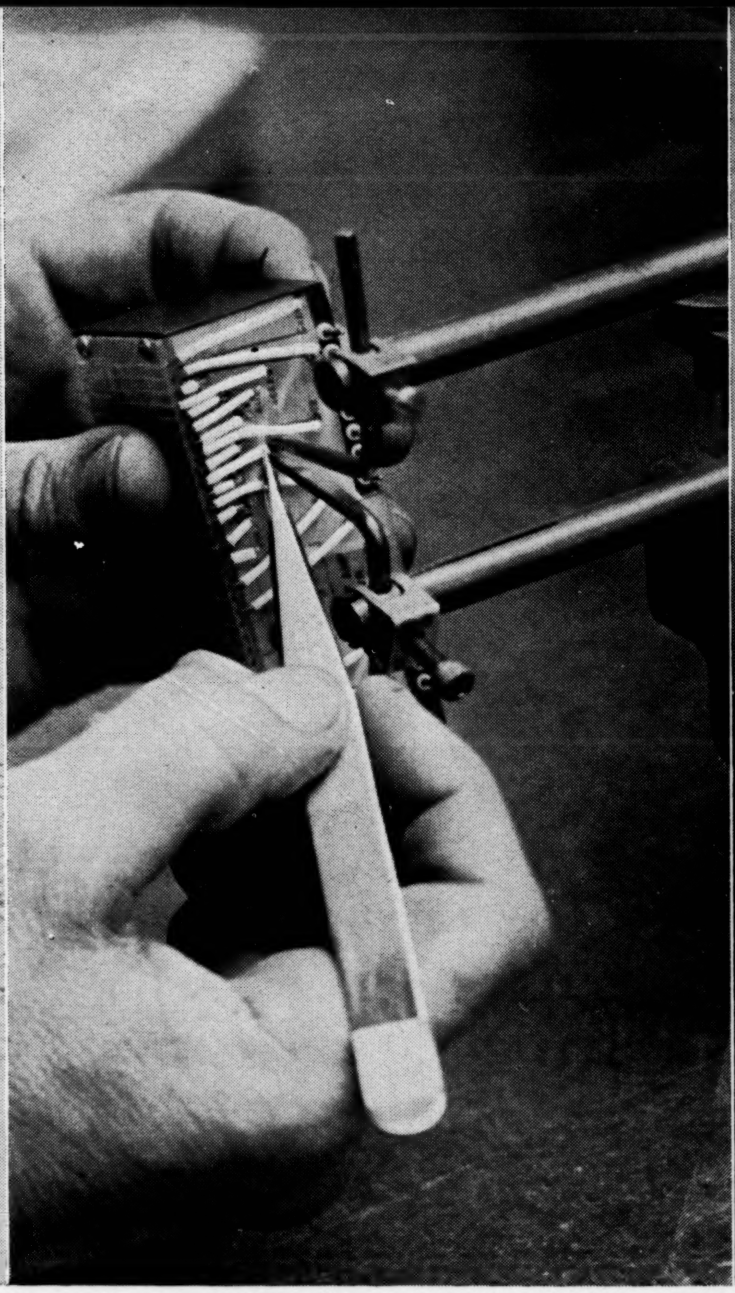
The satellite weighed 270 lb., and was launched by a Thor Able vehicle into an average orbit of 467-429 mi. Pictures were transmitted by two 2-watt FM transmitters over a 235-mc. frequency. Nickel cadmium battery pack was charged by 9,260 solar cells which covered the satellite.

- **Tiros II:** photographic subsystem was identical to that contained in Tiros I. Satellite weighed 282 lb., the additional weight coming from an infrared sensor system to determine the solar energy absorbed and emitted by the earth. The IR system has worked well for research, but the camera system never succeeded in transmitting high quality, wide angle photographs.

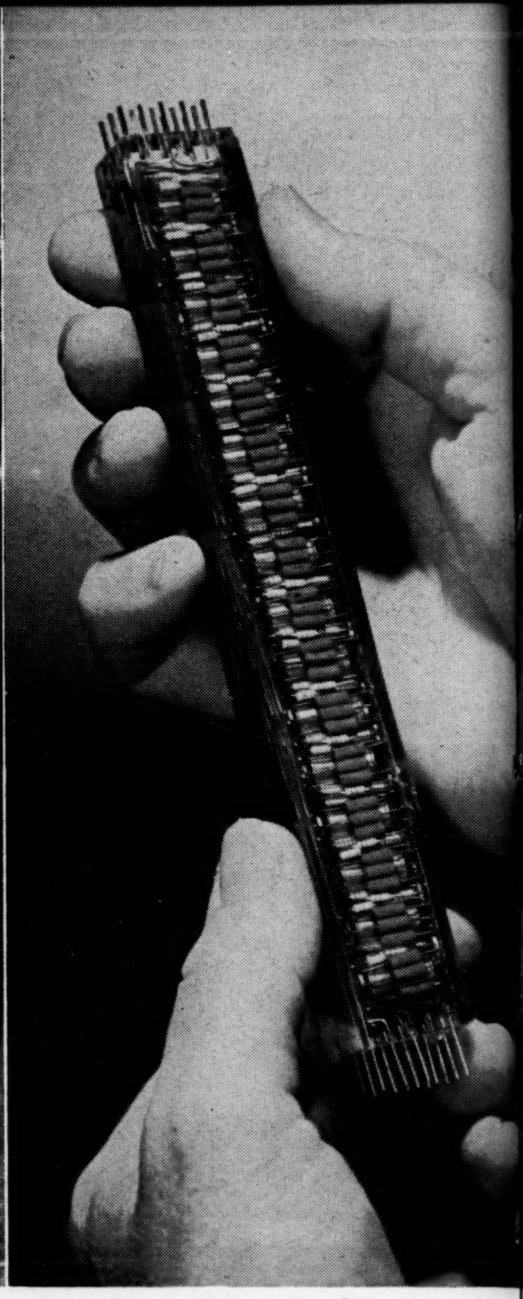
There are several conflicting theories on the malfunction, but the most widespread has been that exhaust from the separation rocket fogged the lens. Picture quality improved slightly, leading to a belief that the exhaust eroded from the lens. Another theory is that the



Package design of Weld-Pak® module



Welding interconnections on Weld-Pak® module



Raytheon Weld-Pak® logic stick

Raytheon "Know-How" Supports M.I.T.'s Advanced Polaris Development

Raytheon is presently devoting part of its unique industrial support talents and facilities to system design engineering and manufacture of electronics for the Advanced Polaris Guidance System. For this program Raytheon is under technical direction of Massachusetts Institute of Technology's Instrumentation Laboratory.

For other university or government laboratories, major missile, space and weapons systems contractors, Raytheon capabilities are ideally suited to basic production design, prototype and production manufacture, flight and environment testing, and field support of operational equipment.

Reinforcing these capabilities is Raytheon experience as prime contractor-systems manager on two major missile programs — U. S. Army's HAWK, U. S. Navy's SPARROW III. Related achievements include Raytheon's famed Weld-Pak® all welded, high density analog and digital components, hydraulic actuating valves of exacting dimensions, electrical power units of extremely favorable power-to-weight ratios, weapons systems radomes, missile guidance miniature rate gyros.

For full information on how Raytheon can lend industrial support to your organization's programs, mail coupon.

SEND TODAY FOR BROCHURE
RAYTHEON COMPANY, Dept. 613A
Lexington 73, Massachusetts

Attention: M. B. Curran

Please mail me brochures checked below:

☐ Welded Electronic Assemblies
☐ Plastics and Components
☐ Aero/Weapons Division General Capabilities

Name..
Title..
Organization..
Address..
City & State..

RAYTHEON

RAYTHEON COMPANY

AERO/WEAPONS DIVISION

stick
port
nce
ajor
vy's
ude
sity
cing
s of
ons
ros.
rial
pon.
Y
N

U.S. NAVY
POLARIS

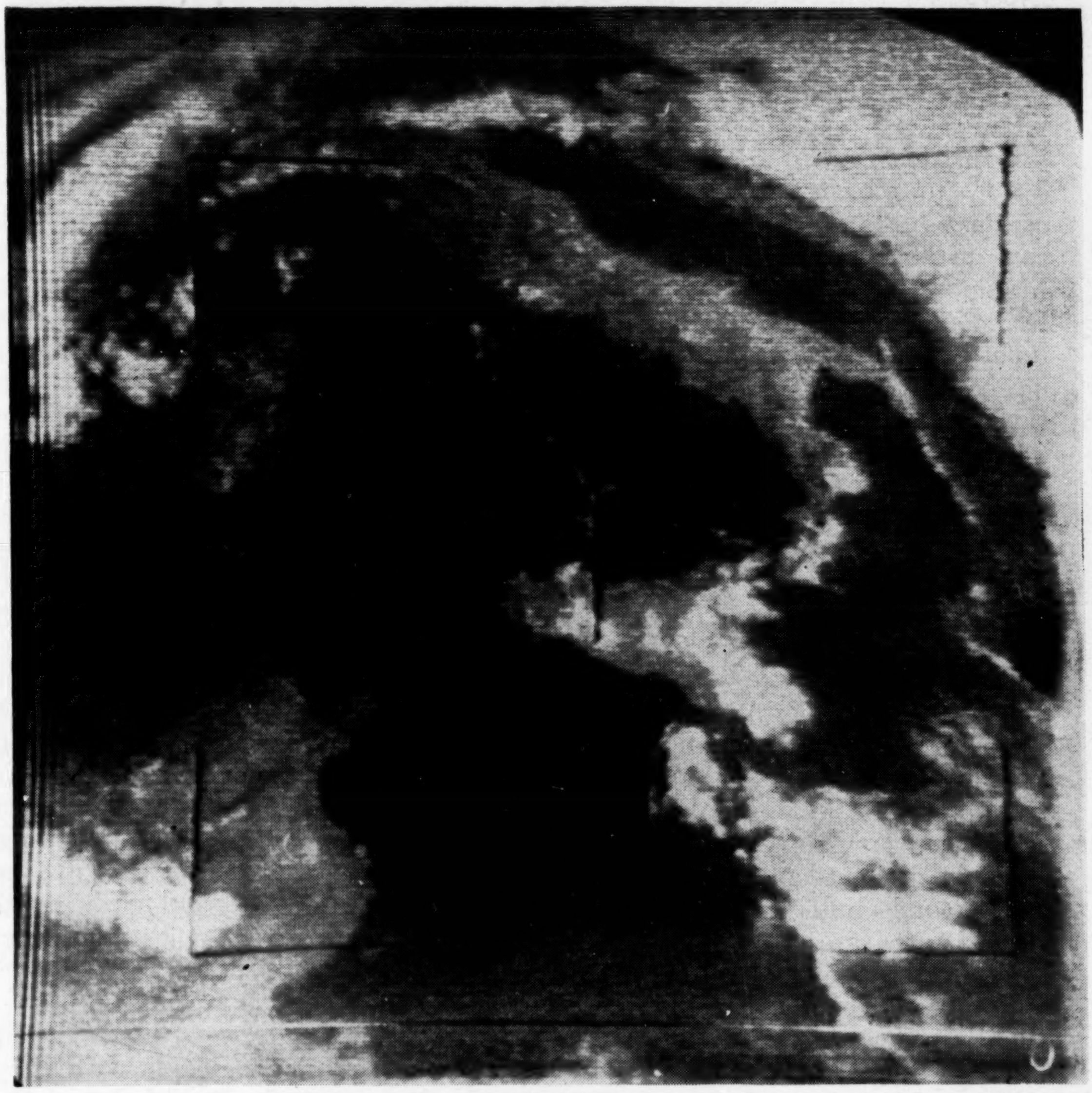
For the Polaris Advanced Guidance System, Raytheon applies PERT-oriented program management techniques throughout, plus the following industrial support functions:

- Circuit Design Assistance
- High Density Packaging
- Instrument Evaluation
- Reliability Tests
- Test Equipment Design
- Documentation
- Rapid Engineering Model Fabrication

RAYTHEON

RAYTHEON
COMPANY

AERO/WEAPONS
DIVISION



CLEAR OUTLINE of the Italian Peninsula, the island masses of Sicily and Sardinia, and the Tunisian coastline is seen in this photograph made Sept. 11 by Tiros III on its 878th pass. This picture was transmitted to the Point Mugu readout station.

camera jarred out of focus at launch. This satellite returned 35,834 photographs during its lifetime, which began Nov. 23, 1960 and ended Sept. 14. About 75% of the pictures were useful. It was launched by a Delta vehicle.

- **Tiros III**: launched July 12, and by mid-September had returned approximately 18,000 useful pictures. With the experience of Tiros II, which indicated that the narrow-angle camera returns pictures very difficult to orient if they cannot be compared with wide-angle pictures, the third Tiros has a system of two wide-angle cameras, and an infrared subsystem. The current Tiros contains an improved dark contrast electronic regulator, to provide a black level in pictures which is more consistent, and an improved focus regulator for both lenses. Deflectors were installed around the lenses to protect them from rocket exhaust. The 285-lb. Tiros III, launched by a Delta vehicle, is in an average orbit of 511-457 mi.

It is likely that the narrow-angle camera will be omitted from the rest of the Tiros satellites, and that two of the remaining four satellites in the series will contain infrared subsystems.

The IR subsystem is one which has even more potential for weather forecasting than television pictures, although IR data now is much harder to display and is considered research rather than operational information. Preliminary analysis has indicated that sensors can determine the net budget—gain or loss—of radiation from the earth's atmosphere, and compare unusual radiations with unusual weather behavior.

Tiros III contains three types of infrared radiometers:

- **Scanning**, which measures returned heat energy by sensors located at an angle to the satellite spin axis.
- **Non-scanning**, measuring total radiation in the vicinity of the earth, and radiation emitted by the sun.
- **Omni-directional**, measuring total solar radiation and long- and shortwave re-radiation from the earth.

The detectors are designed to measure the earth's albedo—radiant energy—and to determine the amount of cloud cover at night when the satellite camera system cannot be operated. They should help measure the temperatures of cloud tops, determine cloud depth and the surface temperature over cloud-free areas.

Standard Tiros satellite operation begins when the payload is separated from the third stage of the Delta launch vehicle. Third Delta stage is spin stabilized at 126 rpm. About 10 minutes after separation, a timer releases a "yo-yo" de-spin system—two weights on opposite sites of the payload—which slow the spin rate to about 12 rpm.

To remain stable in orbit, Tiros must retain a spin rate of at least 9 rpm. When the spin slows below 12 rpm. a set of spin rockets is ignited on ground command. Tiros III has five pairs of spin rockets. Ground stations at Ft. Monmouth, N. J. and San Nicholas Island program the satellite cameras to function through an electronic clock mechanism. Operating like an alarm clock, the timing system is set when the satellite passes over the ground stations. The pictures are stored on magnetic tape, and when they are played back over the ground station, the tape is wiped clean.

Direct Method

Direct picture taking is used when the satellite is within range of Wallops Island or Point Mugu by operating cameras on ground command, skipping the magnetic tape link.

At ground stations, cloud cover pictures are displayed in photograph kinescopes, and both photographic and infrared data are stored on magnetic tapes for permanent recording. IR tapes are processed at NASA's Goddard Space Flight Center, and negatives of cloud cover pictures are sent to the Naval Photographic Interpretation Center here for developing and processing.

Meteorological teams are at Wallops and Mugu for immediate analysis for operational use.

Tiros' Achievements

Washington—Tiros I photographed a storm over the central U. S. the day it was launched, and the Tiros series of weather satellites has made a number of dramatic findings in its 18-month lifetime. Among the most significant are:

- **Tiros I: Photographed a rhombic cloud which spawned five tornadoes in Oklahoma, and began a photographic catalogue of cloud vortices which may provide a means of analyzing specific storm types. This satellite also located a severe tropical storm in an Air Force refueling area near Bermuda, and then spotted a clear area so that the refueling operations could be conducted safely.**
- **Tiros II: Spotted a cold front moving toward New Zealand, which promised relief from a long heat wave during the New Year holiday season.**
- **Tiros III: Photographed all tropical storms so far during the 1961 hurricane season, and discovered Hurricane Esther.**

Meteorologists hesitate to rank the findings in order of significance, since photographs are still under research and analysis.

RCA developed a magnetic coil system, used for the first time on Tiros II, to control the attitude of the satellite. The satellite base is wrapped with a coil of 250 turns of wire, which interact with the earth's magnetic field and allow the satellite to be tilted on ground command. Tiros I was affected by the earth's magnetic forces, which caused the satellite to tilt gradually away from a position vertical to the earth's surface.

Second-generation Nimbus, which actually will be the first operational weather satellite system, will use many of the procedures and systems being proven in Tiros. A major difference is that Nimbus will be earth-oriented at all times, and will be in a polar orbit. Nimbus will weigh about 650 lb. and will be launched from Pacific Missile Range by a Thor Agena vehicle.

The instrumentation systems in Nimbus are being designed for more sophistication than those in the Tiros series. Video camera resolution will be finer, and more advanced IR systems will be used. First Nimbus will contain a high resolution electrostatic tape camera which, if successful, will be the primary photography unit in subsequent Nimbus satellites.

Aeros' Problems

Third generation weather satellite is the Aeros, a payload which has not yet been fully defined. Under current plans, this satellite will be launched into a synchronous earth orbit, at 22,300 mi. altitude, so that it will cover the same portion of the earth at all times. Major problems in this system will be attitude and orbit correction, and a reliable camera system.

Panel on Operational Meteorological Satellites (POMS) has approved a six-year plan for an operational system which would include participation of foreign nations for a truly global network. Fully operational system would begin in 1964 with an annual expenditure of about $60 million, of which $48.2 million would be used for four spacecraft and four Atlas Agena launch vehicles.

Command and data acquisition stations, communications nets and archives are to be funded in Fiscal 1962 and 1963 budgets, at a total cost of about $27 million.

Operational system includes a command station in Fairbanks, Alaska, another on the U. S. East Coast, and a third in Europe. Wallops Island, or a site in Maine, would be used for the East Coast station, and a Scandinavian site is preferred in Europe. Command and data acquisition stations would be situated to cover all orbits.

The POMS report recommends that the Weather Bureau be given responsibility for the meteorological satellite system. It concludes that continuous worldwide coverage is now within the grasp of any nation or group with the interest, skill and resources necessary to develop weather satellites.

The U. S. has the ability to undertake the system, which could become fully operational before 1965, according to the report. Machinery to implement the plan would be establishment of a separate satellite section within the Weather Bureau. Under the plan, NASA will develop satellites to Weather Bureau specifications, and procure and launch vehicles.

Flight Schedule

Flight schedule for the operational system has been divided into three phases:

- **Calendar 1962-63:** one Nimbus in orbit most of the time, which calls for the launch of four Nimbus satellites, each with a six-month lifetime, and two backup payloads.
- **Calendar 1964-65:** one Nimbus satellite in orbit all the time, and a second in orbit most of the time, with research flights beginning on Aeros satellites. This would mean six Nimbus and three Aeros launches, with two Nimbus backup vehicles.
- **Calendar 1966** and beyond: two Nimbus satellites in orbit continuously, and an Aeros in orbit part of the time, with an annual launch of three Nimbus satellites and two Aeros satellites.

Participating in the panel study, which was made under sponsorship of the National Coordinating Committee for Aviation Meteorology, were representatives of Air Force, Navy, Army, Weather Bureau, Federal Aviation Administration and NASA.

Test Rig Measures Ion Propulsion Thrust

Electrical propulsion measuring system capable of handling small thrust measurements of up to 10 lb. has been delivered to USAF Aeronautical Systems Division at Wright-Patterson AFB, Ohio, by Rocketdyne Division of North American Aviation, Inc.

The entire machine, weighing about 5,000 lb., can accommodate an electrical propulsion engine with dimensions up to a 3-ft. cube and weighing up to 200 lb. Power levels ranging up to 250 kw. can be tested in the machine which will be mounted in a vacuum chamber.

Tests of ion propulsion engines will be conducted by suspending the test subject from a pendulum. As the engine's thrust acts to swing the suspension, a counter force will be applied by a magnetic force motor. The current necessary to keep the system in balance serves to measure the amount of thrust of the ion engine.

Two-Axis Gyroscope Uses Spinning Liquid

By Philip J. Klass

Unusual design of two-axis gyroscope which uses a spinning liquid instead of the conventional spinning metal sphere, making the device an extremely sensitive sensor for angular rate and displacement, has been developed by Sperry Gyroscope Co., Great Neck, N. Y.

Sperry has built models of the new fluid sphere gyro which can measure angular rates as low as several hundredths of a degree per hour and which can detect angular displacements as small as 0.01 sec. of arc, according to W. G. Wing, director of the company's inertial systems engineering.

The use of a spinning liquid not only gives the device unusual operating characteristics, but also greatly simplifies gyro design and fabrication. As a result, Sperry expects that the new SYG-2000 gyro will sell for about $2,000 in quantity production.

Company currently is building a pilot quantity of the SYG-2000 gyros for use in an unidentified military project. Continued development of the fluid sphere gyro is being sponsored by the Air Force Aeronautical Systems Division.

Current models of the new gyro measure 2¼ in. in diameter by 6½ in. long and weigh 5 lb. Random drift is quoted at 0.5 deg./hr. and anisoelastic drift at 0.003 deg./hr./g^2.

The gyro can be designed to operate at any temperature between −65F and 200F, and can be stored at temperatures over an even wider range. Warm-up time is eight minutes maximum from any storage temperature, the company says.

Drive motor power consumption is 30 watts.

Operating Principles

The high-density, low viscosity fluorocarbon liquid which serves as the gyro rotor is set spinning by a motor-driven cylindrical member with a spherically shaped cavity which is filled with the liquid. The spinning spherical cavity quickly brings the liquid up to its rotational speed. In some experimental models, spin rates of 12,000 rpm. have been used.

If the gyro case and the spinning spherical cavity are displaced through a small angle, corresponding to a change in attitude of a flight vehicle, the spinning fluid initially will maintain its original spin axis orientation in space. But then fluid shear forces will cause the spinning fluid to precess into alignment with the new attitude of the rotating spherical cavity.

The time constant for this realignment process depends upon several design parameters, some of which can be controlled. In present models, the time constant can be designed for any value from a few milliseconds to about one second. Several techniques now under investigation may increase the time constant, perhaps manyfold, Wing says.

This coupling between the motor-driven cavity and the spinning liquid is one of the unusual characteristics of the new gyro. For a brief interval, it performs in the manner of a conventional displacement gyro, but lacks the long-term spatial stability of a conventional gyro. However, when used with external integrators, the fluid sphere gyro can be used for inertial platform stabilization, according to Wing.

Important Differences

The coupling is similar to that found in conventional spring-restrained rate gyros, but with several important differences. The new Sperry gyro is extremely sensitive to small angular rates about two axes and can handle large angular rates without the hysteresis effects normally encountered in conventional spring-restrained rate gyros, according to Wing.

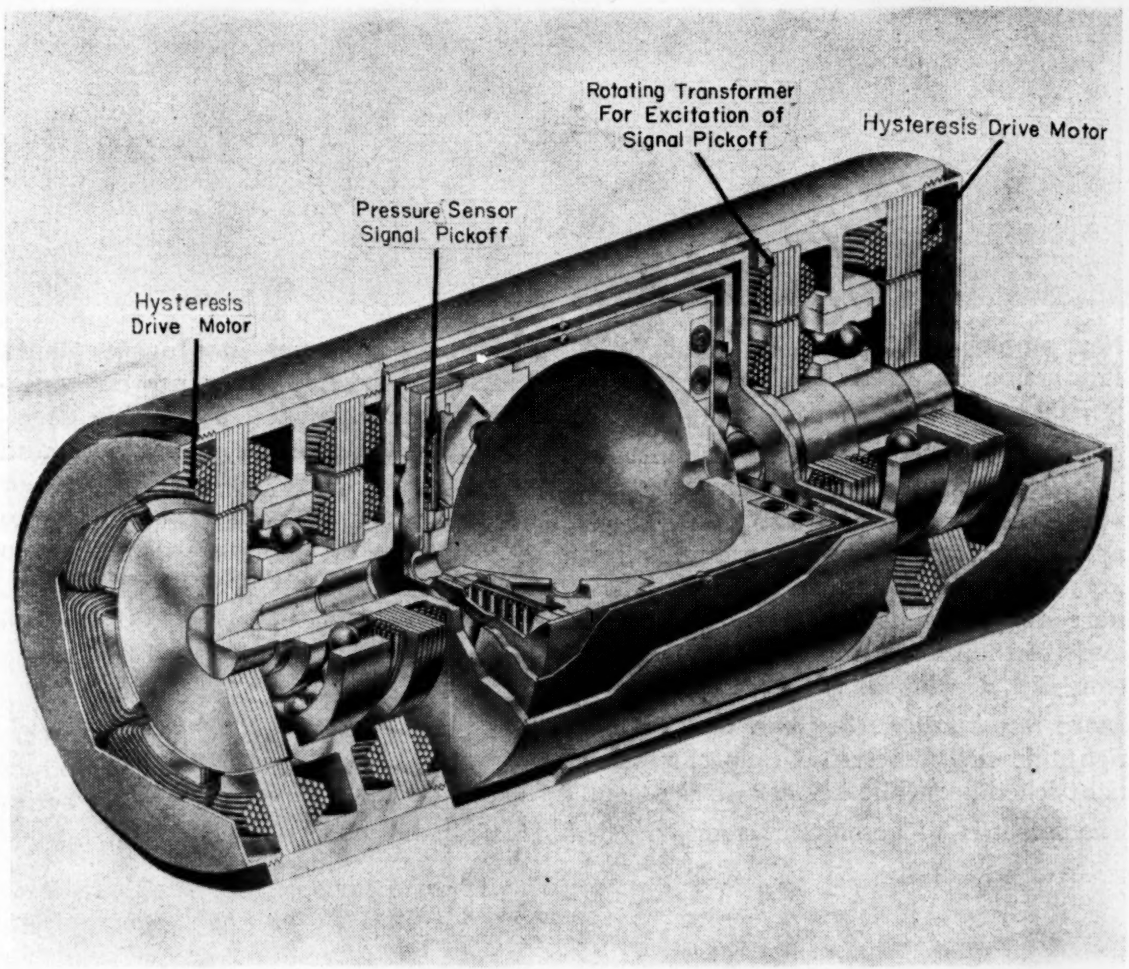
Signal Pickoff

Like the electrostatic suspension gyro and the cryogenic gyro, the fluid sphere device cannot employ a conventional signal pickoff to measure rotor displacement since there is no mechanical connection between it and the external environment.

To sense displacement of the spinning liquid with respect to the rotating cavity, Sperry uses extremely sensitive pressure transducers which functionally resemble a capacitance type microphone. They are excited from an external 50-kilocycle source which is inductively coupled to the rotating member.

Four of these pressure sensors are located in ports in the rotating cavity. Each is situated at an angle of 45 deg. with respect to the cavity rotation axis and displaced 90 deg. from one another around the periphery.

When the spin axis of the fluid corresponds to the rotation axis of the cavity, there is a constant pressure on the transducers which produces no output signal. When the cavity is displaced


Rotating Transformer For Excitation of Signal Pickoff
Hysteresis Drive Motor
Pressure Sensor Signal Pickoff
Hysteresis Drive Motor

CUTAWAY of early model of new gyroscope shows rotating cavity which causes fluid to spin. Sperry two-axis gyroscope uses a spinning liquid instead of conventional spinning metal sphere. Use of spinning liquid simplifies gyro design and fabrication.

How to turn a new face into an old hand

New employee's learning time cut 75%!
Production increased 50%!
Rejects reduced 55%!

Today at Hughes these levels of improvement have become the norm in manufacturing. New employees who don't know a transistor from a thimble become skilled assemblers in days instead of weeks. They start almost immediately to help build some of the most complex electronic systems ever developed.

More importantly, they can build them right the first time. And they can meet tight schedules while keeping costs down. The secret is Videosonic* systems, developed and perfected in Hughes plants. Videosonic systems apply proven audio-visual methods in new and highly developed ways. Recorded instructions and slides guide workers step by step. They *see* what they are to do, as they *hear* how to do it. Each work station is integrated into over-all operations—pace is maintained, flow is smoothed.

Videosonic systems also give immediate measurable results in other areas where efficiency is demanded. Clerical workers can quickly learn new methods. Product testing can be speeded. Engineering activities can be made more effective.

Videosonic systems have proven their merit in 5 years of use in Hughes plants in El Segundo and Fullerton, California and Tucson, Arizona. Today, they assure the reliability and speed production of Polaris missiles, electronic armament systems, Falcon missiles, electronic air defense control systems, and advanced computer systems.

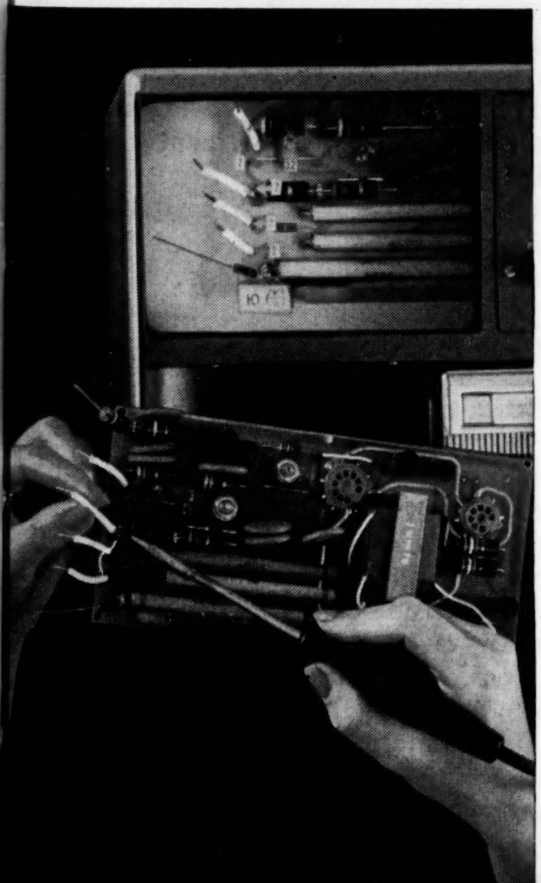
Interested in Videosonic systems for your operation? Hughes has prepared a special booklet detailing the advantages of Videosonic systems. For your copy, please contact: Manager, Videosonic Systems, Hughes Ground Systems Group, Building 381-I, Fullerton, California.

Creating a new world with electronics

HUGHES

HUGHES AIRCRAFT COMPANY

*Trademark Hughes Aircraft Company



with respect to the spinning fluid, a pressure oscillation at the fluid spin rate occurs across the appropriate pair of transducers. The magnitude of the a.c. signal is proportional to the amplitude of displacement and its relative phase indicates the direction of displacement.

By using a pair of transducers for each sensitive axis, and suitably connecting their output windings, the sensors are largely unaffected by external vibrations of the gyro case which otherwise would induce spurious output signals.

Advantages Cited

The use of a spinning fluid as the rotating mass gives the new Sperry gyro a number of unusual features and potential advantages, according to Wing.

These include the following:

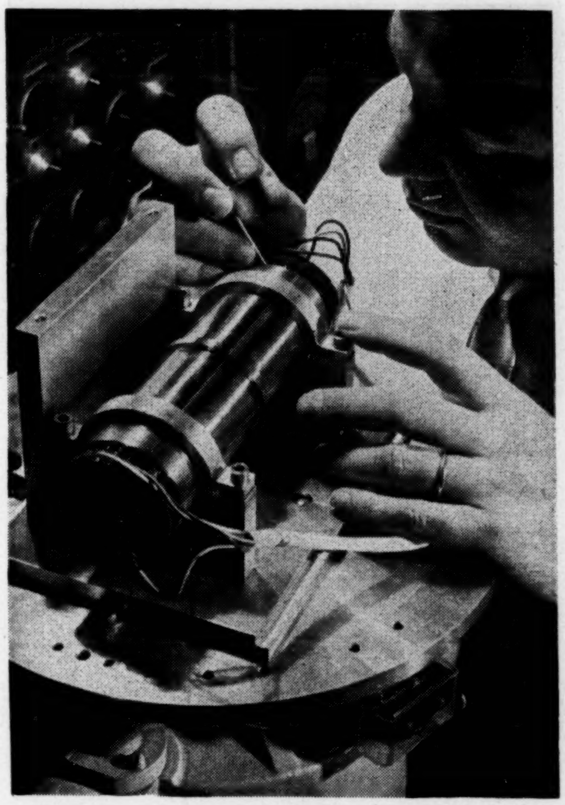
- **Mass balance:** One of the basic requirements for any gyro is that the center of mass of its spinning rotor coincide within very close limits to the center of support. While this requires precision machining and extreme care in assembling a conventional gyro, mass balance is an inherent characteristic of the fluid sphere gyro. If the fluid has uniformity density, its center of gravity automatically centers on the center of support, even when the rotating cavity which induces the fluid spin is itself considerably out of round. The fluid sphere gyro does require modest attention to temperature gradients since axial temperature gradients will cause a variation in density, but this is a relatively easy problem to handle, according to Wing.
- **Isoelasticity:** If a gyro is to maintain low drift rates in the presence of external accelerations, it must either use an extremely rigid rotor or one that is equally compliant in all directions to assure that the center of gravity remains aligned with the center of support or that any displacement occurs in the direction of the acceleration vector so as to not produce spurious torques. These conditions are met by the inherent characteristics of the fluid sphere gyro, according to Wing. The only isoelastic drift results from the compressibility of the fluid in the cavity. Sperry calculations indicate this amounts to only 0.003 deg./hr./g^2.
- **Reliability:** The fluid sphere gyro requires only about one-half as many parts as a conventional sphere gyro, Sperry says. Gyro performance is relatively independent of dirt or other micro-contaminations which can cause malfunctions and/or short operating life in certain types of conventional gyros.

Because the drive motor is external to the spinning fluid mass, any shift in the mass of the drive motor windings during extended use does not introduce any mass unbalance in the spinning fluid. Similarly, rugged non-precision type bearings can be used for the rotating cavity element since any changes in bearing balance with wear does not affect spinning fluid mass balance.

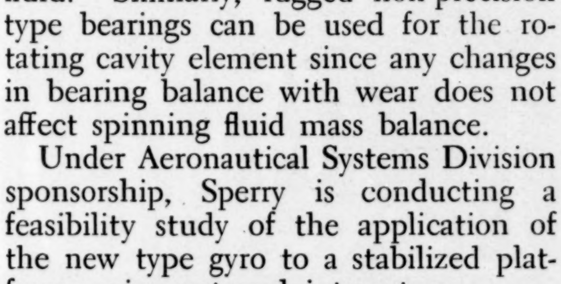
Under Aeronautical Systems Division sponsorship, Sperry is conducting a feasibility study of the application of the new type gyro to a stabilized platform, using external integrators.

Wing is confident that Sperry can produce fluid sphere gyros with random drift rates of only 0.1 deg./hr./g, or about one fifth the drift of early experimental models.

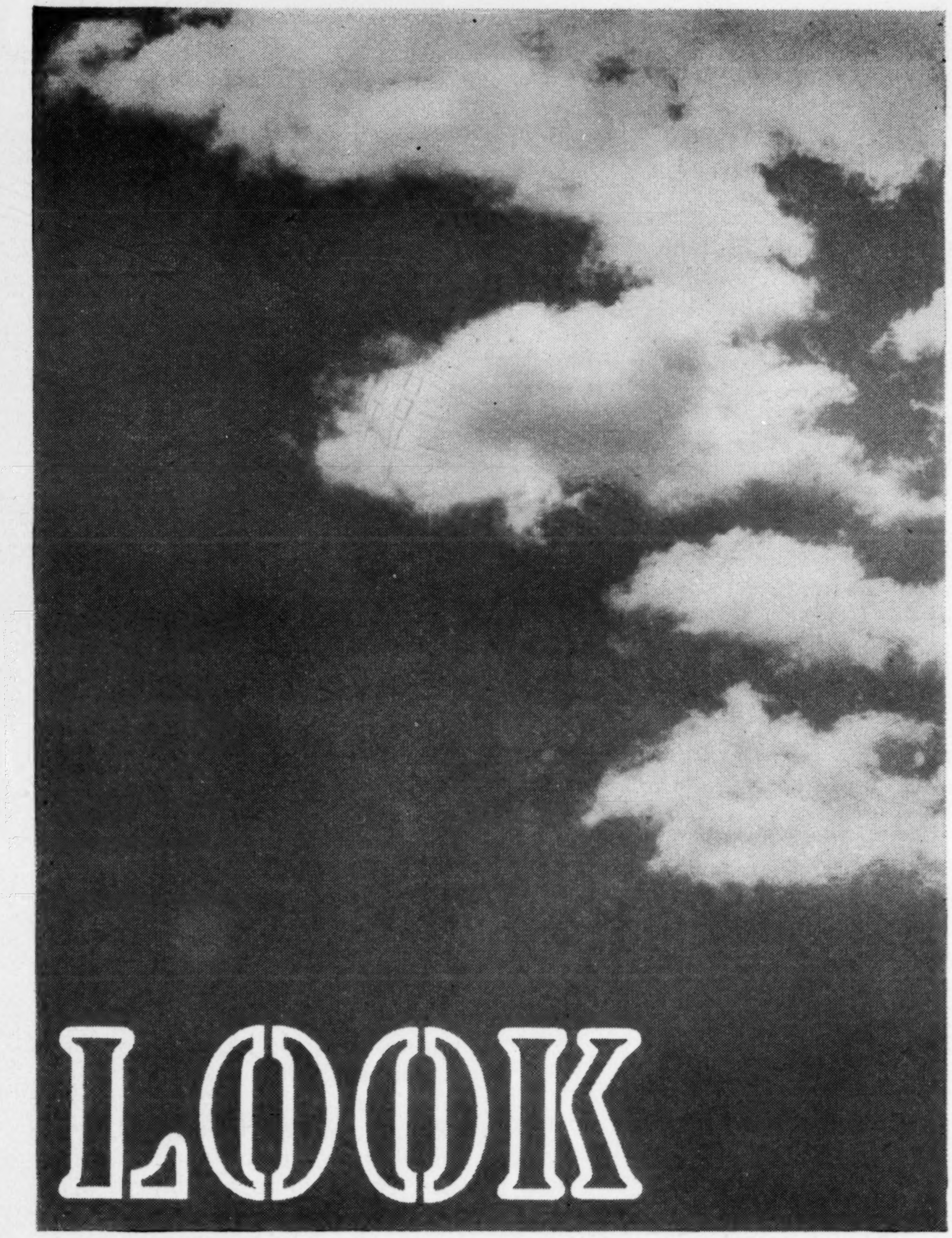
Because such a gyro is expected to have no mass unbalance error, company engineers predict that its performance will be equivalent to a conventional floated gyro with a random drift rate of 0.01 deg./hr. and a mass unbalance drift of 0.1 deg./hr./g when applied to high-altitude, high-thrust flight regimes, such as that of the North American Aviation X-15 rocket research plane.



NEW FLUID sphere gyroscope, which uses spinning mass of liquid instead of conventional metal rotor, can be used as an extremely sensitive rate or displacement type gyro. Gyro uses only half the number of parts of a conventional gyro and should be less difficult and less costly to produce.



SCHEMATIC shows the capacitance-type transducers used to measure change in pressure that occurs when gyro is displaced with respect to spinning fluid sphere.



A SERGEANT MISSILE HAS JUST BEEN LAUNCHED!

Look again, there's not a speck in the sky . . . and yet all day long training crews have been "launching" one Sergeant after another. The Sergeant handling and checkout trainer, developed and now being produced by AAI, allows missile crews to assemble . . . erect . . . check out . . . monitor . . . count down and "fire" without a missile ever leaving the ground. This is another achievement by America's most experienced designer and manufacturer of training, test and simulation systems.

AIRCRAFT ARMAMENTS, INC.
COCKEYSVILLE, MARYLAND

Developers of training and test equipment for:
Sergeant, Redstone, Atlas, Polaris, Nike, Sparrow, Titan, and Terrier Missiles

Acoustic Amplifier Has Wide Application

Fundamentally new type of semiconductor device, called a traveling wave acoustic amplifier, which may be the first of a whole family of new devices capable of operating at high frequencies, has been discovered by scientists at Bell Telephone Laboratories.

The newly discovered principle involves the amplification of ultrasonic waves in a piezo-electric semiconductor crystal through the interaction of the sound waves with electrons drifting in the crystal.

Results of experiments to date suggest that the new principle can be used in a variety of devices, including a traveling wave amplifier, oscillator, isolator, and a delay line which enhances the signal rather than attenuating it.

Using a crystal of cadmium sulfide measuring seven millimeters in length, BTL scientists report that they have achieved gains of 38 db. for a 45-mc. signal and gains of 18 db. with a 15-mc. signal.

The new principle, first proposed by BTL's Dr. D. L. White, is an outgrowth of the discovery last year of the piezo-electric properties of certain types of semiconductors, such as cadmium sulfide and zinc oxide. Subsequent experiments revealed that ultrasonic waves are attenuated in such crystals when they are exposed to light.

More recent experiments showed that amplification can be obtained if a cadmium sulfide crystal is exposed to light and a direct current electric field is applied to the crystal in the direction in which ultrasonic waves are propagating through the crystal.

The amount of amplification obtained depends upon the magnitude of the applied voltage which produces the d.c. field and the conductivity of the semiconductor crystal, which in turn depends upon the intensity of the illumination.

The explanation for the phenomenon advanced by BTL scientists is as follows: When a sound wave travels through a piezo-electric material, it produces a longitudinal electric field which travels along with the wave. If the material also is conductive, this electric field causes currents to flow in the material.

Because the piezo-electric field is periodic, the electrons will bunch together in parts of the ultrasonic wave, interacting with the piezo-electric field. This in turn reacts on the material itself, causing a corresponding change in the velocity and amplitude of the sound wave traveling through the material.

If a d.c. electric field is impressed on the material so as to cause the

Collins Offers PERT

PERT (Program Evaluation Review Technique) scheduling and control program for an IBM 7070 computer, developed by Collins Radio Co. for its own use, is being offered free of charge to other potential users. The PERT program package includes a description of the computer program, a program deck, flow charts, logic diagrams and a description of system operation. The package can be obtained by writing to Charles K. Titus, Collins Radio Co., Communication and Data Systems Division, Cedar Rapids, Iowa. Company reports that it is now applying PERT management technique to nearly 70 military and commercial programs.

bunched carriers to drift in the direction of the wave propagation at supersonic speed, the ultrasonic waves will be amplified in much the same way that electromagnetic waves are amplified in a traveling wave tube, Dr. White theorized.

In recent experiments which confirmed this theory, BTL scientists used a cadmium sulfide crystal which had quartz transducers attached at opposite ends.

One served to convert a radio frequency input pulse into an equivalent sound wave in the crystal, while the other converted the received wave into an equivalent electrical output signal.

The experiments showed that when a d. c. field is impressed on the cadmium sulfide crystal which is dark (unilluminated), there is no effect on the signal passing through the crystal. If the crystal is illuminated but no electric field is applied, the conductivity increases and the sound wave is attenuated.

But when the crystal is illuminated and a sufficient voltage is applied to it, substantial signal amplification occurs.

To provide an unequivocal confirmation of the existence of net acoustic gain in the crystal, BTL scientists conducted a test in which no signal was applied but the crystal was illuminated and subjected to a d. c. electric field. In time, thermal noise within the crystal material built up acoustic energy, producing ultrasonic waves. The amplification was more than sufficient to compensate for losses due to reflection at the crystal-transducer bonds, causing the crystal to break into oscillation. This suggests that the new principle can be applied to oscillators as well as to amplifying devices.

Theory suggests that the new traveling wave acoustic amplifier may be able to operate at frequencies in the gigacycle (kilo-megacycle) region, but this has not yet been proven by experiment, a BTL spokesman says.

Present plans call for a study of the noise characteristics of the new device which is expected to have a noise figure comparable to tunnel diodes. It is expected that cooling of the crystal will lower its noise figure, within limits.

There is a variety of possible piezoelectric semiconductor materials which might be used. Generally these are the class 2-6 and 3-5 compounds. Cadmium sulfide and zinc oxide are representative of the first type, while gallium arsenide and indium antimonide are typical of the second class.

FILTER CENTER

▶ **New Role for Electric Typewriter?**—Rome Air Development Center scientists are considering a new role for the familiar electric typewriter: as an individual office output/input device for military communications systems. Major problem at present is that a hard-copy message can be transmitted half way around the world in a few seconds, but once it arrives at the major military facility there is no speedy way to deliver it to the individual for whom it is intended. Since most military offices already have electric typewriters, RADC is considering them as hard-copy output/input devices. A buffer storage element would have to be added to temporarily hold messages until the machine was available, but this could be a modest sized and priced device.

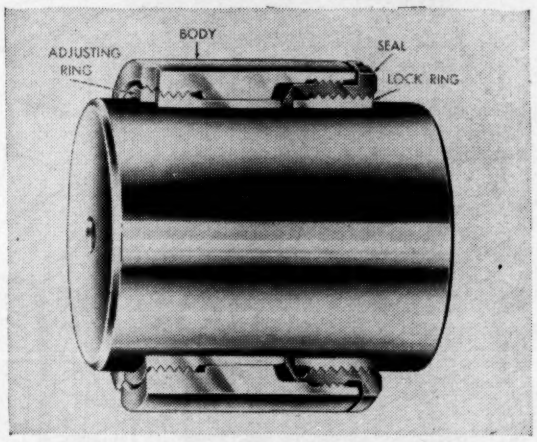
▶ **Radar Hazard Being Surveyed**—New York University, under RADC sponsorship, is conducting a survey with the cooperation of 25 companies that make or test radar and high-power microwave equipment. Objective is to gather statistics to evaluate hazard, particularly to human eyes, of working near radar equipment. Survey will include both employes exposed to radar and those in unexposed office or factory jobs to ascertain if the former have a higher incidence of eye degradation.

▶ **Soviets Report New Photo-Emission Phenomenon**—Russian scientists report that the maximum energy of photoelectrons emitted from N-type crystal blocks of gallium arsenide is independent of the energy of incident light quanta over the interval of 4.66 to 5.46 electron-volts, a phenomenon which has not previously been observed.

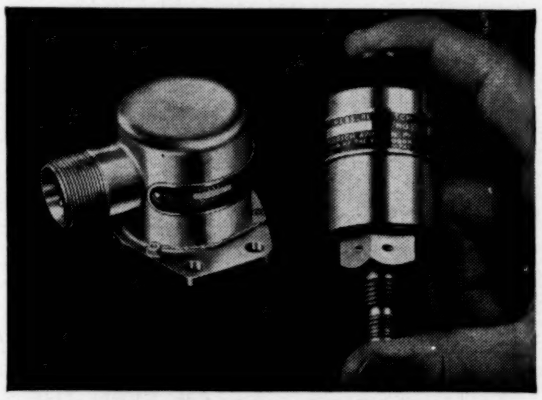
▶ **Soviets Develop Pneumatic Computer**—Miniature pneumatic computer, capable of performing simple arithmetic operations and solving integral and differential equations, has been developed in the Soviet Union. The computer

Ideas you can use from

B.F.Goodrich



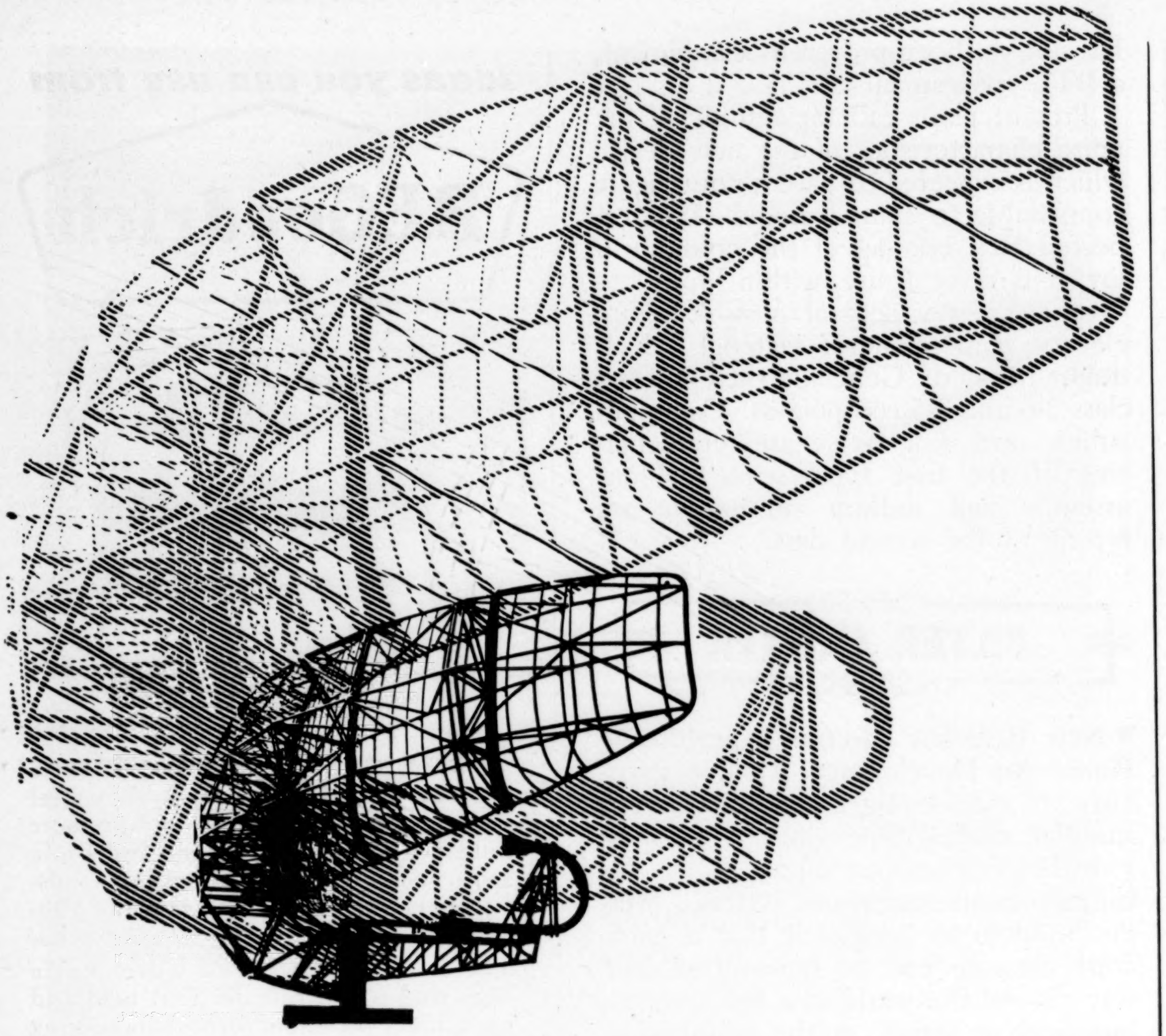
ALL-METAL SEALS FOR VERY HIGH PRESSURES AND TEMPERATURES. New high-alloy steel seals withstand temperature and pressure extremes in critical dynamic and static applications. Preliminary tests show satisfactory performance in the range of 500-1000°F and pressures up to 20,000 p.s.i. The BFG seal utilizes a blunt knife edge with a controllable unit load and has a lower break-out force than existing metallic seals.



PRECISION PRESSURE-SENSING SWITCHES. BFG pressure switches respond to absolute, gage, or differential pressures in liquids or gases. Omega-design bellows actuate switch contacts at preset pressures. Standard AN electrical connectors are integral to the switch.

METAL-CLAD DE-ICERS. BFG bonds electrothermal heating units, sealed in glass-reinforced resin, to the outer surface of metal leading edge sections. Metal skin withstands rain, dust, or hail at high speeds, functions dependably. Units are lightweight, form a smooth air foil.

For more information check your B.F.Goodrich Aviation Products Representative, or write *Aviation Products, a division of The B.F. Goodrich Company, Dept. AW-10A, Akron, Ohio.*



SAFETY OF LIFE IN THE AIR

SELENIA AIR TRAFFIC CONTROL RADAR OFFERS:

SOLID LONG RANGE, HIGH ALTITUDE DETECTION OF EVEN THE SMALLEST TYPES OF AIRCRAFT THROUGH THE USE OF HIGH AVERAGE POWER AND A PARAMETRIC AMPLIFIER RECEIVER.

THE MOST ADVANCED TRUE MTI SYSTEM IN THE WORLD WITH THREE PULSE CANCELLATION FOR CLUTTER-FREE PRESENTATION AND STAGGERED REPETITION RATE FOR BLIND SPEEDS ELIMINATION.

THE USE OF L-BAND ASSURES SHARP AZIMUTH DISCRIMINATION AND LOW PRECIPITATION ATTENUATION WITH REASONABLY SIZED ANTENNA STRUCTURES.

SPECIAL HIGH-LOBE ANTENNA FOR GREATLY IMPROVED SUBCLUTTER VISIBILITY FOR CLOSE-IN TARGETS AND CIRCULAR POLARIZATION FOR NEARLY COMPLETE CANCELLATION OF RETURNS FROM PRECIPITATION.

A RADAR COMPLETELY COMPATIBLE WITH JET AGE REQUIREMENTS.

A DIRECT SUCCESSOR OF THE PROVEN RAYTHEON AIRPORT AND AIRWAYS RADARS CHOSEN BY THE AIR TRAFFIC CONTROL AUTHORITIES IN CANADA, THE UNITED STATES AND SWITZERLAND.

Your inquiry
is invited for more
specific information
ROME ITALY
P.O. BOX 7083

MANAGED BY
RAYTHEON

SELENIA

Excellence in Electronics in Europe

consists of metallic washers with diaphragms made of rubberized linen which form miniature chambers to receive in-flow of compressed air. Operation of the device is controlled by stopcocks in the tubes which carry the compressed air. Computer is described in USSR publication Ekonomicheskaya Gazeta, Aug. 7, 1961.

▶ **Call for Papers**—Air Force Cambridge Research Laboratories will hold a symposium on "The Plasma Sheath—Its Effect Upon Re-entry Communication and Detection" Apr. 10-12 in Boston. Both classified and unclassified technical sessions will be held. Prospective authors should submit 200-word unclassified abstracts by Oct. 15 to Miss Alice Cahill, Code CRRD, AFCRL, L. G. Hanscom Field, Bedford, Mass.

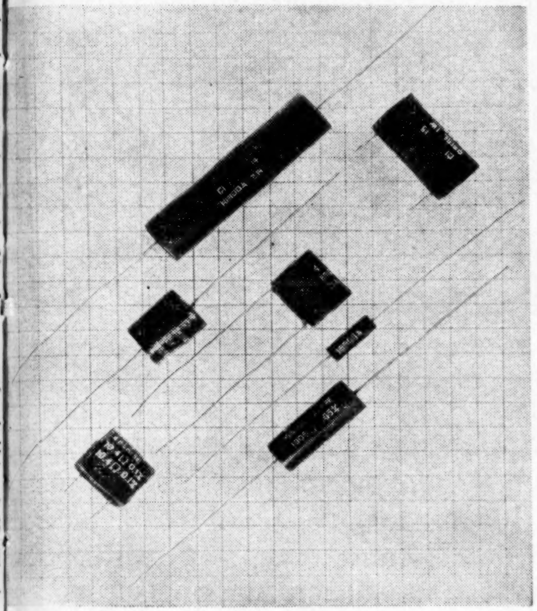
▶ **ONR Schedules Two Symposia**—Symposium on optical character recognition, sponsored by the Office of Naval Research, will be held Jan. 15-17, and another on redundancy techniques for computing systems will be held Feb. 6-7. Both will be given in the Department of Interior auditorium in Washington D. C. Further details are available by writing: Miss Josephine Leno, Code 430A, Office of Naval Research, Washington 25, D. C.

▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

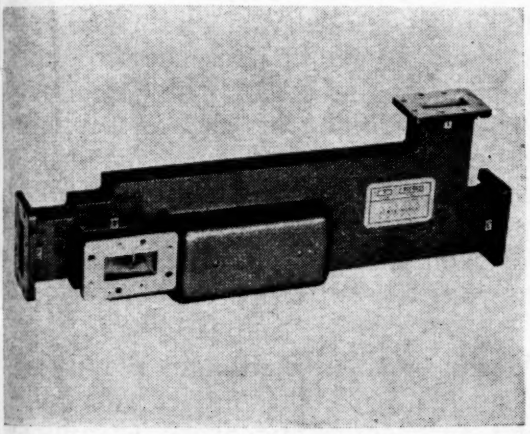
- **General Atronics Corp.,** Bala-Cynwyd, Pa., will conduct one-year theoretical and experimental program to establish feasibility of new technique for detection of ICBM nose cones and space vehicles under a $300,786 contract from Air Force Ballistic Systems Division. Technique is expected to provide information on target velocity, acceleration, rotation and geometric form factor from each radar pulse in addition to its range and position, company says.
- **Hallicrafters Co.,** Chicago, $3 million for airborne electronic warfare penetration systems for use on Strategic Air Command bombers, from USAF Aeronautical Systems Division.
- **Melpar, Falls Church, Va.,** $76,600 award from Aeronautical Systems Division for continued investigation of electronic neurons for application to flight control and other systems suitable for satellite controls.
- **Sperry Gyroscope Co.,** Great Neck, N. Y., $5.4-million Air Force contract for engineering installation and on-site testing of high-power frequency diversity radars.
- **Electro Mechanical Research, Inc.,** Sarasota, Fla., $80,000 for a pulse duration modulation-to-digital conversion system, from USAF Air Proving Ground Center.

NEW AVIONIC PRODUCTS

• **Precision wirewound resistors,** in values from 1 ohm to 75 megohms with tolerances from 0.01, 0.05, and 0.1% in welded, encapsulated units. Wattage ratings are specified at 125C, derated lineally to zero power at 180C. Standard temperature coefficient is 10 ppm. with 1 ppm. to 6,000 ppm. available on request. Resistors meet MIL-R-93B and MIL-R-9444. Manufacturer: CGB Components, Inc., 14621 Arminta St., Van Nuys, Calif.



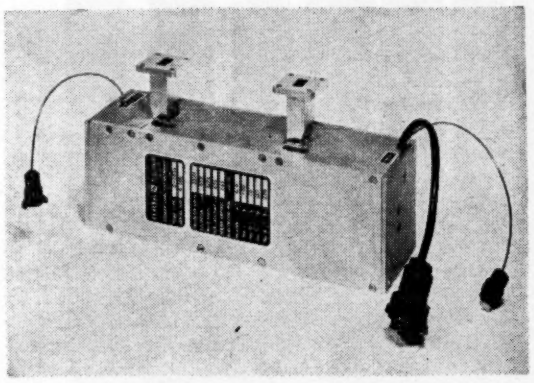
• **Circulator, Model CXB-205,** a four-port waveguide circulator developed for communication link applications, will handle 300 watts average and operate over temperature range from −55C to 71C. It can be used in frequency range from 5.925 to 6.425 kmc. and provides 20 db. minimum isolation, insertion loss less than 0.25 db., vswr of 1.15 max. Manufacturer: Rantec Corp., Calabasas, Calif.



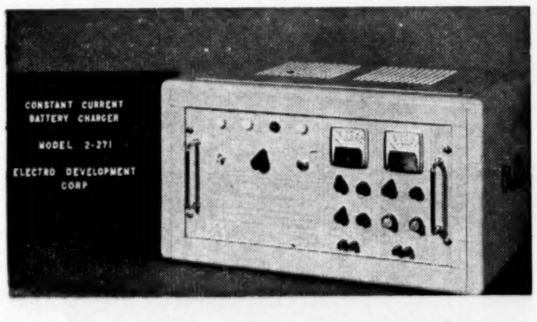
• **Magnetic tape recorder,** Model 2101, records 14 tracks with laboratory precision in missile environments and weighs 13 lb. This airborne recorder consists of precision tape transport and electronic module assembly. Plug-in modules provide choice between 14 tracks of wideband FM recording and combination of seven tracks FM and seven tracks of direct analog recording. Frequency response is d.c. to 10 kc. in wideband FM and 50' to 100,000 cps. in direct record at tape speed of 30 ips. Tape packing density is 3,300 cps. Manufacturer: Westrex Recording Equipment Division, Litton Industries, 335 No. Maple Dr., Beverly Hills, Calif.

• **Ferrite isolators,** Models J103, X103 and XL102 for use at J-band (5.85 to 8.2 kmc.), X_u band (8.2 to 12.4 kmc.) and X_1 band (7.05 to 10 kmc.), are transverse field, resonance absorption devices designed to maximize load isolation, maintain low insertion loss and hold vswr to low level. These isolators exhibit typical performance characteristics of 30 db. min. isolation, 1 db. insertion loss and 1.15 max. vswr over specified operating frequency band. Manufacturer: Motorola, Inc., Solid State Electronics Dept., 3102 No. 56th St., Scottsdale, Ariz.

• **Traveling wave tube,** Model Z-3031, a low-noise K_u amplifier with saturated power output of 5 milliwatts and noise figure of less than 14 db. across its frequency range of 14 to 18 kmc. Gain of tube is at least 25 db. Supplied as complete package including permanent magnet focusing assembly, waveguide input and output connectors, entire tube weighs 11.5 lb. It is intended for use in ECM gear, microwave relay systems and as preamplifier in radar receivers. Manufacturer: General Electric Co. Power Tube Dept., Schenectady 5, N.Y.



• **Universal battery charger,** Model EDC 2-271, supplies constant current adjustable from 0.1 to 10 amp. to any type of sealed or unsealed battery (up to 50 volts). Transistorized battery charger automatically shuts off when battery reaches full charge. It also has automatic cycling mode. Manufacturer: Electro Development Corp., 4530 Union Bay Pl., N.E., Seattle 5, Wash.



McGraw-Hill
BOOK NEWS

ELECTROMECHANICAL COMPONENTS FOR SERVOMECHANISMS

Just Out. Clearly explains how to choose and apply rotating components to achieve most effective and efficient system operation. **By Sidney A. Davis, Consulting Electrical Engr.; and Byron K. Ledgerwood, Chief Ed., Control Engineering. 342 pp., 315 illus. & tbls. $11.50**

PROGRAMMING COMPUTERS FOR BUSINESS APPLICATIONS

Just Out. Provides a sound basis for programming computers geared to business applications. Offers guidance to what a programmer must do, including a series of didactic programming examples. **By Ned Chapin, Stanford Research Institute. 275 pp., 91 illus., $7.50**

TRANSISTORS AND ACTIVE CIRCUITS

Just Out. Presents practical information to help you solve basic transistor circuit problems. Includes physics of semiconductors, two-port network theory, and transistor circuits. **By John G. Linvill and James F. Gibbons, both of Stanford Univ. 511 pp., 403 illus. & tbls., $14.50**

ELECTRONIC MEASURING INSTRUMENTS

Just Out. Full data on today's electronic instruments—how they work . . . what they do . . . how they are used in measurement and control systems. Includes a wide range of equipment: test and checking instruments, components, and systems for counting, simulation, and computation. **By H. Soisson, Gen. Elec. Co. 352 pp., 328 illus., $7.50**

METEOR SCIENCE AND ENGINEERING

Just Out. Describes major engineering results in meteor science . . . effects of meteors in upper atmosphere, on weather, etc. Covers radio and optical observation techniques, use of forward-scattering properties in communications, etc. **By D. McKinley, Natl. Research Council, Ottawa, Can. 309 pp., 124 illus., $12.50**

10 Days' FREE Examination

McGraw-Hill Book Co., Dept. AV-10-2
327 W. 41st St., New York 36, N. Y.

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep plus few cents for delivery costs, and return unwanted book(s) postpaid. (We pay delivery costs if you remit with this coupon—same return privilege.)

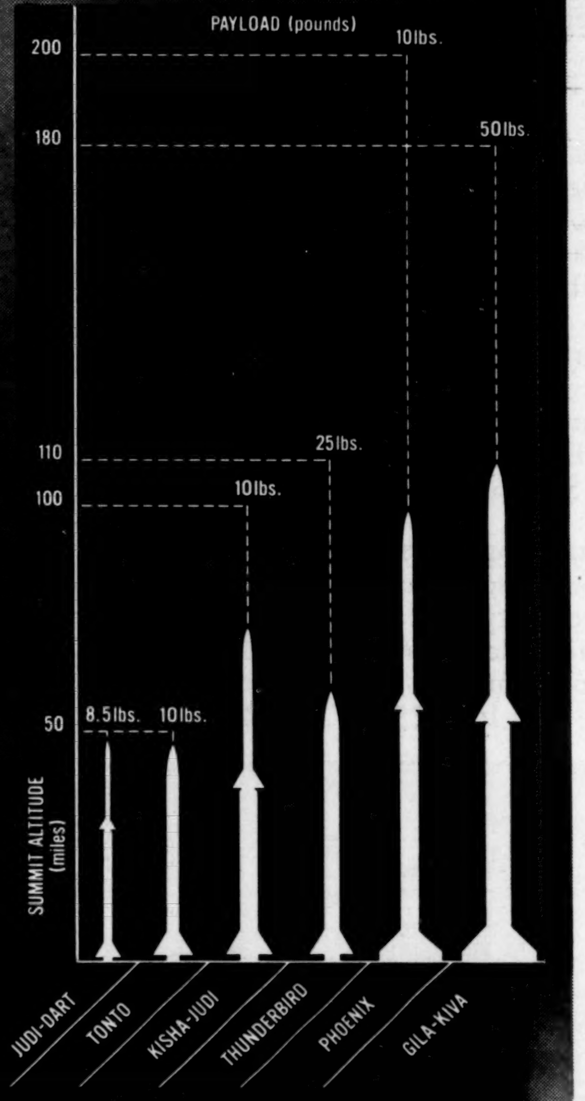
☐ Davis & Ledgerwood—**Electromech. Components for Servomech.**, $11.50
☐ Chapin—**Programming Comp. for Bus. Appli.**, $7.50
☐ Linvill & Gibbons—**Transistors & Active Circ.**, $14.50
☐ Soisson—**Elec. Measuring Instruments**, $7.50
☐ McKinley—**Meteor Science & Engrg.**, $12.50

Name ....
Address ....
City .... Zone.... State.......
Company ....
Position ....

For price and terms outside U.S.
Write McGraw-Hill Intl., N.Y.C. 36 **AV-10-2**

RPI *space age support provides...*

SOUNDING ROCKETS AND ROCKET MOTORS WITH...



PROVEN SOLID PROPELLANT PERFORMANCE

These high-performance sounding vehicles are only examples of Rocket Power's solid propellant accomplishments . . . ranging from a variety of standard solid propellant rocket motors to second-generation propellant R & D projects.

RPI's technical abilities, depth of experience and advanced production and loading facilities combine to provide a complete rocket and solid propellant capability. If your project requires rocket vehicles, rockets, propellant-actuated devices or gas generating cartridges, call RPI, today.

FOR COMPLETE INFORMATION on RPI rocket motors and rocket vehicles, write for Technical Bulletin #1200.

ROCKET POWER INC.

FALCON FIELD / MESA, ARIZONA

PRODUCTION BRIEFING

Japanese government has approved a request from Mitsui & Co. to manufacture Fuji Bell 204B 12-passenger helicopters under license from Bell Helicopter Co. Agreement calls for production by Fuji Heavy Industry of 100 units by the end of 1968, of which 40 helicopters would be delivered to the Japanese Self-Defense Agency and the remaining 60 units would be available to private industry and for export. Mass production is scheduled to begin toward the end of next year.

Bell Aerosystems Co. will measure control responses and accelerations of its one-man rocket belt (AW June 12, p. 33) under a contract from Aerospace Medical Laboratory, Air Force Systems Command. Data from these stability, performance and control studies will be applied to follow-on rocket belt designs.

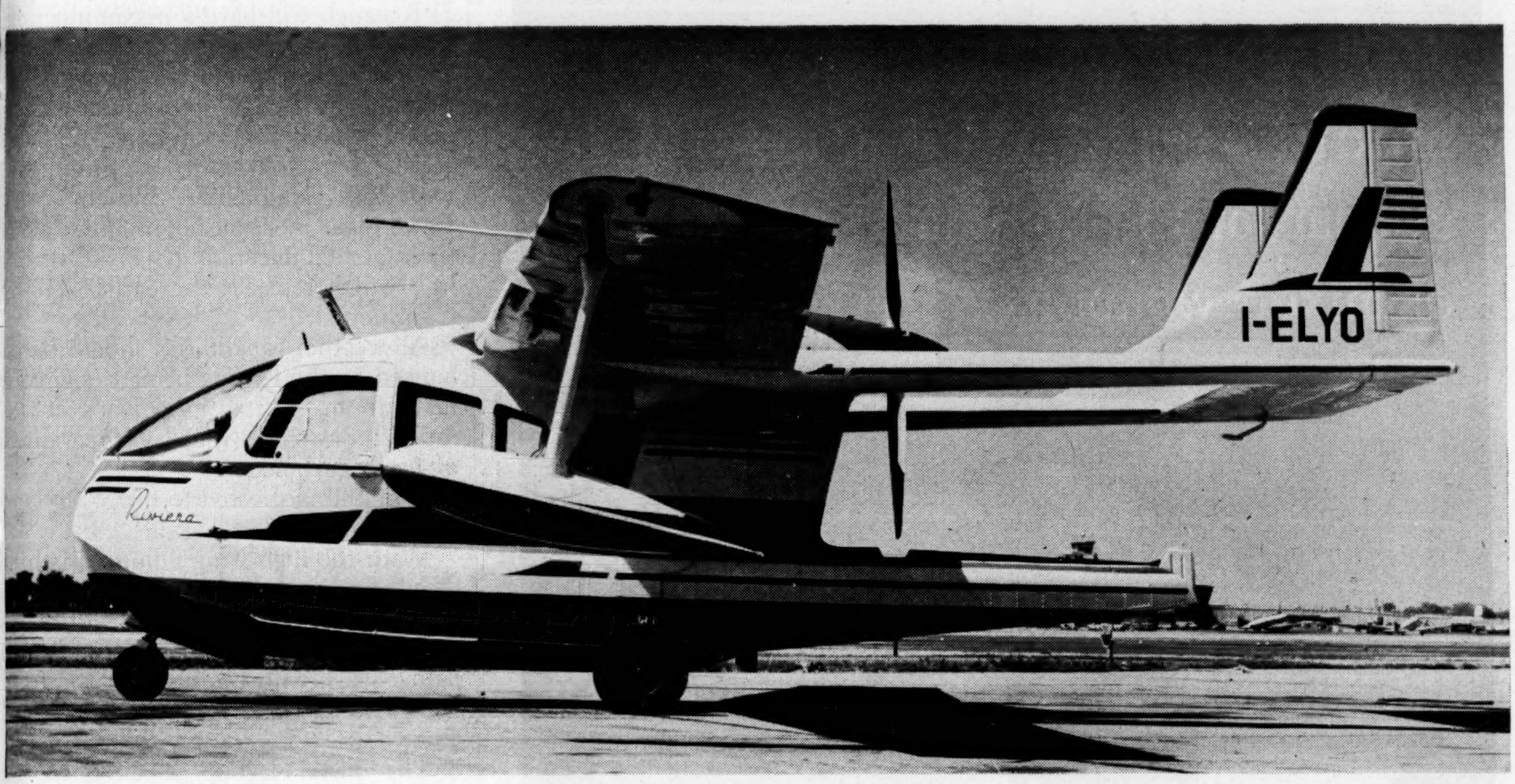
Dow Corning Corp. of Midland, Mich., is producing and marketing a new family of heat, cold and oxidation resistant materials called fluorosilicones that are insoluble in most solvents and incompatible with most petroleum oils. Produced in fluid, compound and grease forms, the materials behave similarly to dimethyl silicones, but also have good solvent, fuel and chemical resistance and improved lubricity.

Air Force has awarded a contract to Republic Aviation Corp. for research slated toward improving structural design requirements for aerospace vehicles. The contract also calls for investigation of internal components such as piping, electrical harnesses and equipment supports. The study will cover the period from the vehicle's exit from the earth's atmosphere through space operation and atmospheric re-entry.

Martin Co.'s Baltimore Division has signed a $310,000 contract with National Aeronautics and Space Administration to build approximately 50 heat exchanger units for Saturn C-1 boosters.

Ling-Temco-Vought, Inc.'s Temco Aerosystems Division has received a $1.5-million contract for reconditioning and modification of Air Force Douglas C-133 transports. Major modification called for is preparation of aircraft to receive a new type propeller and subsequent installation of the propellers.

Hayes Corp., Birmingham, Ala., has received a $2,215,869 Air Force contract for production of multi-purpose pylon assemblies for F-100 aircraft.



HARTZELL PUSHER PROP, fully reversible to aid in docking the Italian-built amphibian, can also be used while maneuvering the four-placer on the ground. Riviera, as the SIAI-Marchetti F.N.333 is designated by U. S. distributor Lane Aircraft, is priced at $34,950, minus radio. Tip floats fair neatly into Riviera's fully cantilevered wings, reducing drag to provide about 150 mph. cruise speed.

Riviera Amphibian to Be Marketed in U.S.

By Erwin J. Bulban

Dallas, Tex.—First four-place Lane Riviera single-engine amphibian, designed and built by Savoia Marchetti in Italy, will soon start an extensive demonstration tour in the U. S. to indoctrinate potential customers and dealers in the new Dallas company's marketing program.

The airplane, the fifth prototype F.N. 333, recently arrived at Love Field here from New York and made its public debut at the National Business Aircraft Assn.'s annual forum at Tulsa, Okla., Sept. 26-28. It was then scheduled to be shown at National Pilot Assn.'s annual meeting at Tulsa following the NBAA show. Then Lane Aircraft Co. Executive Vice President Jerry Spear plans to take it to Aircraft Owners & Pilots Assn. convention, St. Petersburg, Fla., Oct. 9-15, prior to a swing to the Pacific northwest the latter part of October. There he will make it available for demonstration by a Lane dealer in Seattle, who reportedly has several firm prospects. Spear will then fly the amphibian to Santa Monica, Calif., for showing to a prospective dealer.

Lane Aircraft, which is sole distributor in this country for the airplane, feels that its best dealer prospects are among those outlets which have specialized in multi-engine business aircraft and that wish to add a new single-engine plane to their line to bolster their marketing programs.

Spear explained to Aviation Week that his company has laid out these guidelines for prospective dealers—they must have available adequate service facilities and maintain a stock of approximately $3,500 in spares that are not available in the U. S. and they must provide an instructor qualified in seaplane operations, because the company will insist on providing customers with complete checkout in the aircraft and its systems, including having the customer pilot make approximately 50 water takeoffs and landings.

Lane itself will stock approximately 30% of the dollar value of spares needs based on the outcome of its demonstration programs. The company, headed by David T. Lane, has offices in the Exchange Bank Building, Dallas, and operates from nearby Love Field.

Certification Received

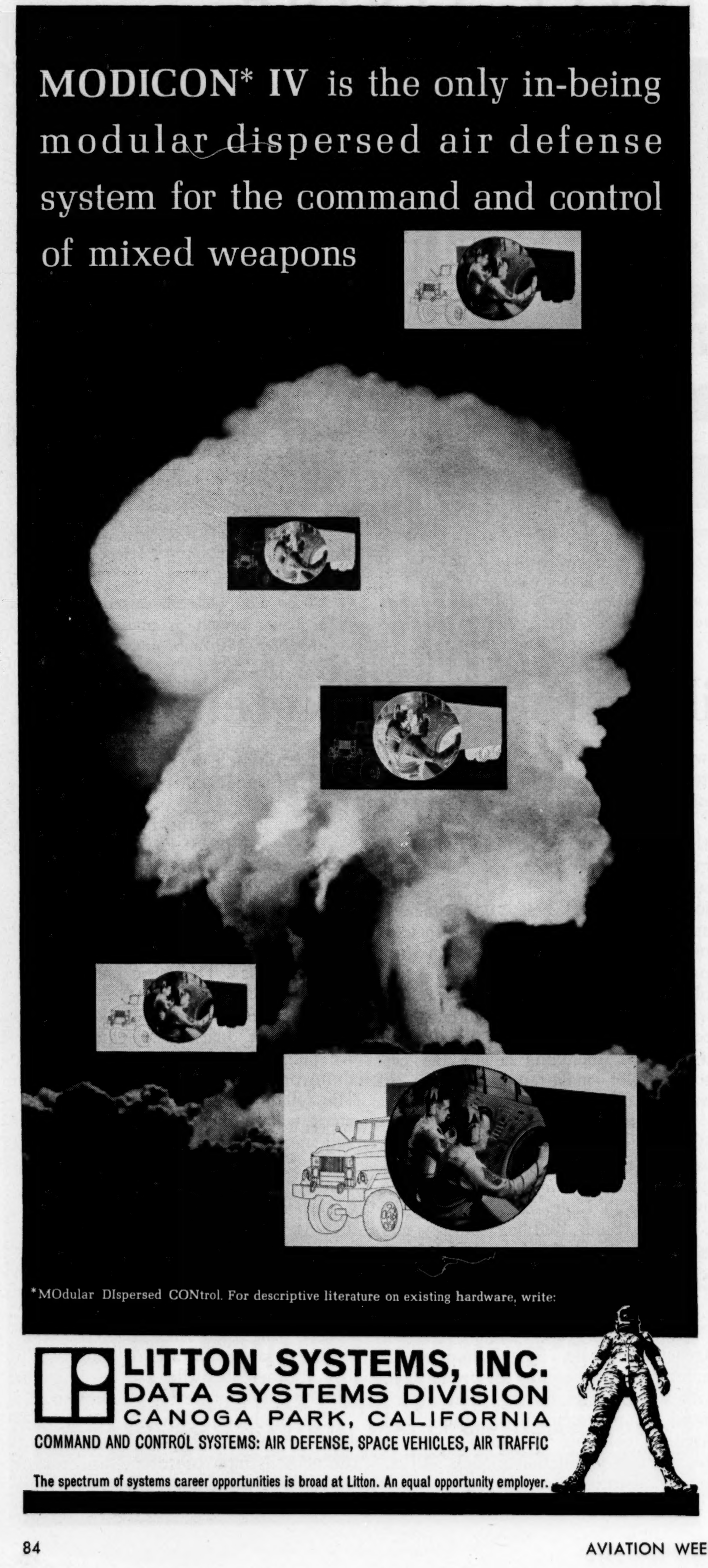
Spear reported that the Riviera amphibian has a full Federal Aviation Agency certificate. The Italian manufacturer is now tooling for production, with some delays having been experienced in procurement of specialized machine tools, but the outlook is that the first two production models will be completed next January.

Build-up would probably be four aircraft in March, a six per month rate in April and eight per month by the end of 1962.

Retail price of the basic Riviera amphibian will be $34,950 minus radio, which will be optional depending on customer's choice. Radio installations will be made either by the distributor, Lane Aircraft, at Associated Radio, Love Field, or by the dealer, to customer specifications. The basic price will include a full instrument flight rules (IFR) panel, with dual gyros and vacuum pumps, dual controls, ground service plug for battery cart starts to save drain on the battery, full-reverse pitch Hartzell propeller, a hydraulically operated water rudder, four-color paint scheme, corrosion proofing throughout to U. S. Navy specifications and stainless steel cables.

Inspection of the demonstrator here at Love Field indicated that the Riviera is a ruggedly built airplane, probably designed on the heavy side compared with U. S. practice. Spear noted that production airplanes will have a lighter-weight wing than the prototypes, providing a saving of approximately 170 lb. Another 30-50 lb. will be pared in refining the airplane for production.

The production Riviera will have a gross weight of 3,270 lb., the same as the demonstrator prototype, and useful load will be 1,045 lb.—sufficient to handle four people with full gas comple-



MODICON* IV is the only in-being modular dispersed air defense system for the command and control of mixed weapons

*MOdular DIspersed CONtrol. For descriptive literature on existing hardware, write:

LITTON SYSTEMS, INC.
DATA SYSTEMS DIVISION
CANOGA PARK, CALIFORNIA
COMMAND AND CONTROL SYSTEMS: AIR DEFENSE, SPACE VEHICLES, AIR TRAFFIC

The spectrum of systems career opportunities is broad at Litton. An equal opportunity employer.

ment, including auxiliary tankage, of 6 gal. Production plane, with complete IFR panel, will have a maximum range of 930 mi. with no reserve, Spear stated. He said the airplane will cruise at approximately 145-150 mph. indicated airspeed, which the company feels is a requirement if it is to be competitive with its landplane contemporaries. Powerplant is a pusher-mounted Continental fuel-injection IO-470-P of 250 hp., which replaces the earlier 240-hp. Continental.

All-weather capabilities should be enhanced by the Riviera being designed to take up to 45 fps. gust loads at 149 mph. indicated, which is a condition of heavy turbulence.

The hull is stressed to take 7.2g landing loads.

With the high wing mounted behind the large windows and wide entrance doors on both sides, the Riviera features easy access to the cabin's rear and front paired seats, with the backs of the front seats folding down to further facilitate entry.

The panel layout is designed for ease of maintenance, a simple piano-type hinge splitting the panel top in half. Removing a pin opens up the entire top of the turtle-deck for checking behind the panel. Instrument removal is facilitated by quick-opening fasteners that permit the board to be pulled out.

Propeller reverse lever is located between the front seats overhead on the windshield divider strip. Pulling the lever and pushing the throttle in not only cuts braking time and aids in docking the amphibian, but comes in handy when positioning the airplane on land.

Spear said he had used the feature for backing up on the ground.

Water rudder is retracted or extended using a button mounted on the wheel. One modification Lane insisted on is removal of the landing light from a vulnerable position in the bow to the wings. The present window-mounted air vents will be replaced by conventional U. S. type indirect cabin vents.

Turbo-Flight to Sell Potez 840 in America

Henri Potez and Turbo-Flight, Inc., of Chicago have signed a sales agreement whereby Turbo-Flight becomes the exclusive North American sales agent for the Potez P.840 turbine-powered, four-engine light transport aircraft.

Turbo-Flight has ordered a demonstrator aircraft to be delivered in April, 1962, and has taken an option on all 24 Potez 840s scheduled to be produced in 1962 (AW May 29, p. 71). The company also will be parts and service representative for North

America and is negotiating with 11 fixed-base operators in the United States, Canada and Mexico.

The fixed-base operators will provide regional service facilities if agreements are reached. Turbo-Flight will maintain a spare parts depot in Chicago.

Sales of the P.840 will be handled through independent sales associates who will work on a direct commission basis, assisted by a Turbo-Flight demonstration team. Continental Motors will provide service and parts distribution for the aircraft's Turbomeca Astazou engines.

Don Payton, Turbo-Flight president, said the firm was formed to bring a European aircraft of the P.840 class on the U.S. market. Chief stockholder in the company is Daniel Peterkin, president of Morton Salt Co.

The Potez P.840, a 16-24 seat aircraft designed for feeder-line and executive use, has been a privately financed venture so far. Recently, Potez has been considering an offer by the Irish government to produce the P.840 in Ireland.

Speculation in France now is that the French government will advance production aid to keep the work in France. The French military services are reported considering the P.840 as a replacement for its DC-3 transport fleet. If the aircraft is selected, the military might order as many as 30 aircraft. Turbo-Flight says deliveries can be made 18 months after a firm order is placed.

PRIVATE LINES

Piaggio Douglas PB-808 utility turbojet transport will be powered by two Bristol Siddeley Viper 20 engines of 3,000 lb. thrust each. First flight of a prototype PB-808 is expected in 1962. The Viper 20 powerplants will enable the PB-808 to cruise at 40,000 ft. at 500 mph.

First Super EQM Catalina has been delivered to Selco Exploration Co., Ltd., by Timmins Aviation, Ltd., of Montreal. The Catalina conversion, being offered by Timmins in several configurations including high-density passenger, cargo, and executive models, will cruise at 5,000 ft. at 192 mph. with 55% of power. Gross weight is 32,000 lb. A tanker version is under development for use in fighting forest fires.

Cessna has changed its international sales meeting from Oct. 15-17 to Oct. 22-24 because of restrictions which will be imposed on air travel Oct. 14 by operation Skyshield, a military exercise during which all civilian aircraft movements will be banned.

No major changes have been incorporated in the Piper Colt or Comanche 180 for 1962. Both aircraft feature new paint schemes which basically are a white fuselage, wings and tail with a choice of four to six trim colors. Comanche 180 has a newly designed cabin interior and a "ruggedized" Lycoming engine. Prices on the two 1962 models have not yet been announced by the firm.

Beech Aircraft Corp. has been testing Stratographic horizon indicator developed by Coffing Industries, Inc., Covington, Ind. The instrument presents indicator aircraft figure superimposed on converging grid lines, giving the appearance of earth's surface disappearing into distance. Grid lines are at specific degrees of separation to permit accurate banks to be established, Coffing says.

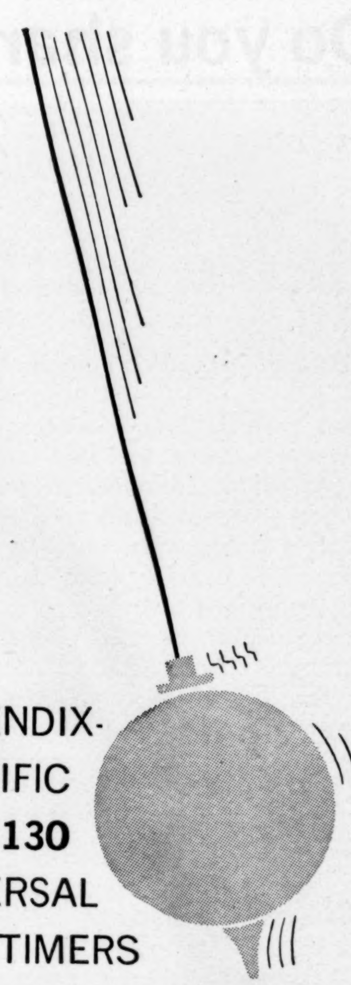
Canadian Department of Transport has taken delivery of a Sikorsky S-62 helicopter. The aircraft will be used for resupply and inspection work on Canada's west coast.

Modification of a Beech T-34B to 260 hp. in place of standard 225-hp. Continental engine has been developed for U.S. Forest Service by Pacific Airmotive Corp., Burbank, Calif., to improve the plane's performance in fire fighting operations. T-34B is used by Forest Service as a lead plane to direct activities of aerial tankers, requiring slow flying over rugged terrain. Conventional powerplant lacked power and cooling necessary for unusual operations under inherently poor flying conditions in extremely high-temperature areas.

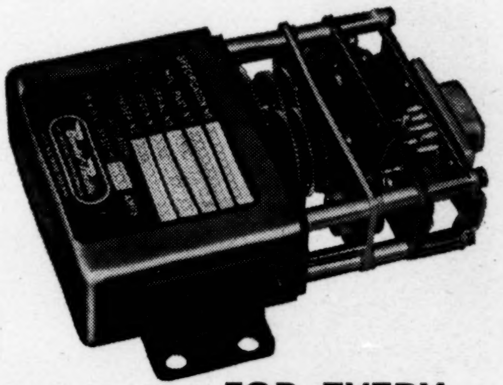
Acquisition of General Aviation Supply Co., St. Louis, Mo., by Van Dusen Aircraft Supplies, Teterboro, N. J., extends the latter company's operations to 14 major cities. Addition will be known as the company's Gasco Division at present.

Fourth de Havilland Heron has been added to Queen Elizabeth II's personal transport section of the British Royal Air Force. Three previous Herons have flown more than one million miles with members of the royal family and distinguished guests.

Federal Aviation Agency has approved wingtip tanks for the 1961 Piper Comanche 250. Tanks increase usable fuel capacity to 90 gal., or to 120 gal. if the airplane is equipped with Piper's optional wing tanks. Tanks are manufactured by Brittain Industries, Inc., Hawthorne, Calif., and weigh a total of 24 lb. per pair.



BENDIX-PACIFIC
SERIES 130
UNIVERSAL
TIMERS



FOR EVERY APPLICATION WHERE ACTION OCCURS AS A FUNCTION OF TIME

- * Constant Speed Motors ±5% ungoverned ±1% governed
- * Modular gear train covers wide timing range. Weight 9 oz.
- * Wide selection of switches, reset clutches, variable inductors and capacitors and potentiometers.
- * Inquire about programming of circuits rated as high as 40 amps.

Contact Bendix-Pacific when your design requires—
ACTUATORS
Geneva-Loc • Conventional Rotary
Linear • High-Response •
Safe & Arm
TIMERS
Sequential Programming
Repeat Cycle • Adjustable

Bendix-Pacific Division
NORTH HOLLYWOOD, CALIF.

THE Bendix CORPORATION

Do you share his reluctance to accept the accepted?

Doubt is his dogma. He questions everything, takes nothing for granted — not even his own answers.

Do you share his stubborn skepticism? Then come to Northrop, where the breadth and variety of projects give ample scope to the most determined questioner. Northrop's divisional organization makes it possible to support a broad range of programs from countermeasures systems and airborne computer design to techniques for aero-space deceleration and re-entry, and the maintenance of a total human environment in space.

Top priority, just now, goes to senior aerodynamicists and computer circuit designers. But whatever your specialization, if you're the kind of man Northrop needs, there'll always be an opening for you. Why not get in touch with us today and find out more? Just write to Northrop Corporation, Post Office Box No. 1525, Beverly Hills, California.

NORTHROP

AN EQUAL OPPORTUNITY EMPLOYER

CAB Accident Investigation Report:

Approach Planning Cited in Electra Crash

At approximately 0800 EST, Sept. 14, 1960, a Lockheed Electra, Model L-188A, N 6127A, owned and operated by American Airlines, Inc., struck a dike and crashed during an approach to a landing at LaGuardia Airport, New York, N.Y. Approximately half of the 76 persons on board suffered minor injuries or shock; no one was killed. The aircraft was severely damaged by impact forces and fire.

The Electra scheduled as Flight 361 departed Boston at 0716 EST, with its destination St. Louis, Mo., and with a planned intermediate stop at LaGuardia Airport. About 10 min. prior to departure a crew change was made when a check pilot boarded the aircraft to flight-check the flight engineer. This check pilot, by mutual agreement with the crew and in accordance with existing company policy, took over the left or pilot-in-command seat with the previously assigned captain moving to the jump seat.

The trip was routine until final approach at LaGuardia.

It is the Board's opinion that the pilot, in attempting to land as short as possible, did not properly plan the approach and as a consequence misjudged the height of the aircraft above the ground when crossing the dike.

As a result of this investigation and hearing, two recommendations were sent to the Federal Aviation Agency.

1. On Sept. 22, 1960, it was recommended that the "Visual Glide Slope System," then undergoing tests by the FAA, be applied to LaGuardia Airport as soon as practicable.
2. On Dec. 13, 1960, it was recommended in a letter to the Administrator that the present procedures for providing illumination of passenger exit markings be re-examined.

Other factors of this investigation are being studied, one of which is the evacuation of an aircraft when upside down.

Investigation

American Airlines Flight 361 of Sept. 14, 1960, a Lockheed Electra L-188A, N 6127A, was a scheduled passenger flight between Boston, Mass., and St. Louis, Mo., with an intermediate stop at LaGuardia Airport, New York, N.Y. The crew consisted of Captain Gordon E. Staples, First Officer Herbert E. Schleicher, Flight Engineer Kenneth F. Thoman, and Stewardesses Margaret Fleming and Donna Gilligan.

Prior to departure the crew was briefed on the available terminal and en route weather conditions as well as pertinent forecasts. The local Boston weather at 0600[1] was clear; visibility 15 mi. plus; wind west-northwest 10 kt.; altimeter 29.97.

Accordingly, a flight plan was prepared by the crew which specified a flight from Logan Airport, Boston, to LaGuardia Airport, in accordance with Visual Flight Rules (VFR), at a cruising altitude of 8,500 ft., true airspeed 260 kt., and an estimated time en route of 45 min.

Approximately 10 min. prior to departure, Supervisory Captain Sheldon E. Pangburn boarded the aircraft for the purpose of conducting a semi-annual flight check of Flight Engineer Thoman. With Captain Staples' consent and in accordance with existing company policies, Captain Pangburn occupied the left pilot's seat and Captain Staples moved to the jump seat located immediately behind the captain's station.

The flight departed at 0705.

The gross takeoff weight at the time of departure was 91,367 lb.—well under the maximum allowable gross takeoff weight of 99,250 lb. Fuel on board weighed 17,600 lb. and estimated fuel burnoff on the Boston-LaGuardia leg of the flight was 3,600 lb. There were 70 passengers on board.

At 0752, Flight 361 called LaGuardia approach control and reported it was over New Rochelle VFR. The flight was then given the following clearance: "American 361, LaGuardia approach control, at New Rochelle contact LaGuardia Tower 118.7, runway 31, wind west-northwest 18, altimeter 30.02, field information taxi eight closed, runway 31, 4,900 ft. long, have you in radar contact . . ." Flight 361 acknowledged and at 0755 reported to LaGuardia Tower that it was overhead and gave the wind as northwest 20 kt. In the landing pattern at this time were American Airlines Flight 518, No. 1 to land; and N 5AA, a Beechcraft Travelaire, No. 2 to land; Flight 361 was given the No. 3 position.

Just prior to the time Flight 518 landed, the tower advised another aircraft, N 16D, then approaching the outer marker that the wind was northwest 30. Flight 518 and N 5AA landed and reported clear of the runway respectively at 0758 and 0759. At 0800:27, in answer to a query from Flight 361, the tower advised "361 cleared to land." Flight 361 acknowledged, and this was the last radio transmission from the aircraft.

At 0800:50, N 16D called the tower and advised that an aircraft had crashed on the airport. Emergency equipment was immediately alerted. Tower personnel later stated that at the exact moment of the crash their attention was diverted from the American Electra by other local traffic.

LaGuardia Airport is bounded on three sides by water. Because the surface of the airport is located at a height nearly level with the water, a dike has been constructed around the water sides of the airport to prevent flooding. This dike is 161 ft. from the approach end of runway 31 and stands approximately 8.2 ft. above the runway surface and 13.7 ft. above the mean water level. The dike is sodded and its top surface is somewhat irregular.

Investigation revealed that all four main landing gear tires had struck the upper portion of the wooden bulkhead on the waterside of the dike. In going over the top of the dike the left wheels trenched to a depth of 9¼ in. and the right wheels 5¾ in., the difference being the result of the irregularity in the dike surface. Accurate measurements indicated that the aircraft was 0.2 deg. right wing down and that the main gear was 1.3 ft. below the top of the dike at the time of initial contact.

Crash Description

After initial impact, Nos. 1 and 2 propellers struck the ground 131 ft. farther on. The aircraft rolled to the left and pitched down. In so doing it became inverted and reversed in direction. The left wing was torn off partially by the force against the landing gear when it struck the dike and tore completely away on contact with the ground. Fire which started in the left wing immediately upon impact and in the right wing during the rollover was confined to the exterior of the aircraft until all passengers had evacuated. The aircraft was substantially damaged by impact forces, smoke, and fire. The aircraft came to rest approximately 1,000 ft. from the dike and 150 ft. to the left of the left edge of the runway and heading approximately 153 deg.

When the aircraft stopped sliding, its occupants found themselves hanging upside down by their safety belts. To add to their confusion, the inside of the cabin was darkened by mud and soot on the outside window panes. The emergency lights in the cabin were not lighted. Some passengers were able to extricate themselves; others needed assistance. All on board turned to and did the job. The stewardesses, who were seated in the rear lounge, did an excellent job in allaying the fears of the passengers by quickly calling out the necessary instructions for debarkation. The lounge exit door was dislodged and partially open. The stewardesses and a passenger moved this heavy door sufficiently for it to be used as an exit. They immediately called to the passengers to come to the rear of the aircraft. A passenger attempted to open the buffet service door but was unsuccessful. Everyone questioned said there was no panic and that the evacuation was orderly.

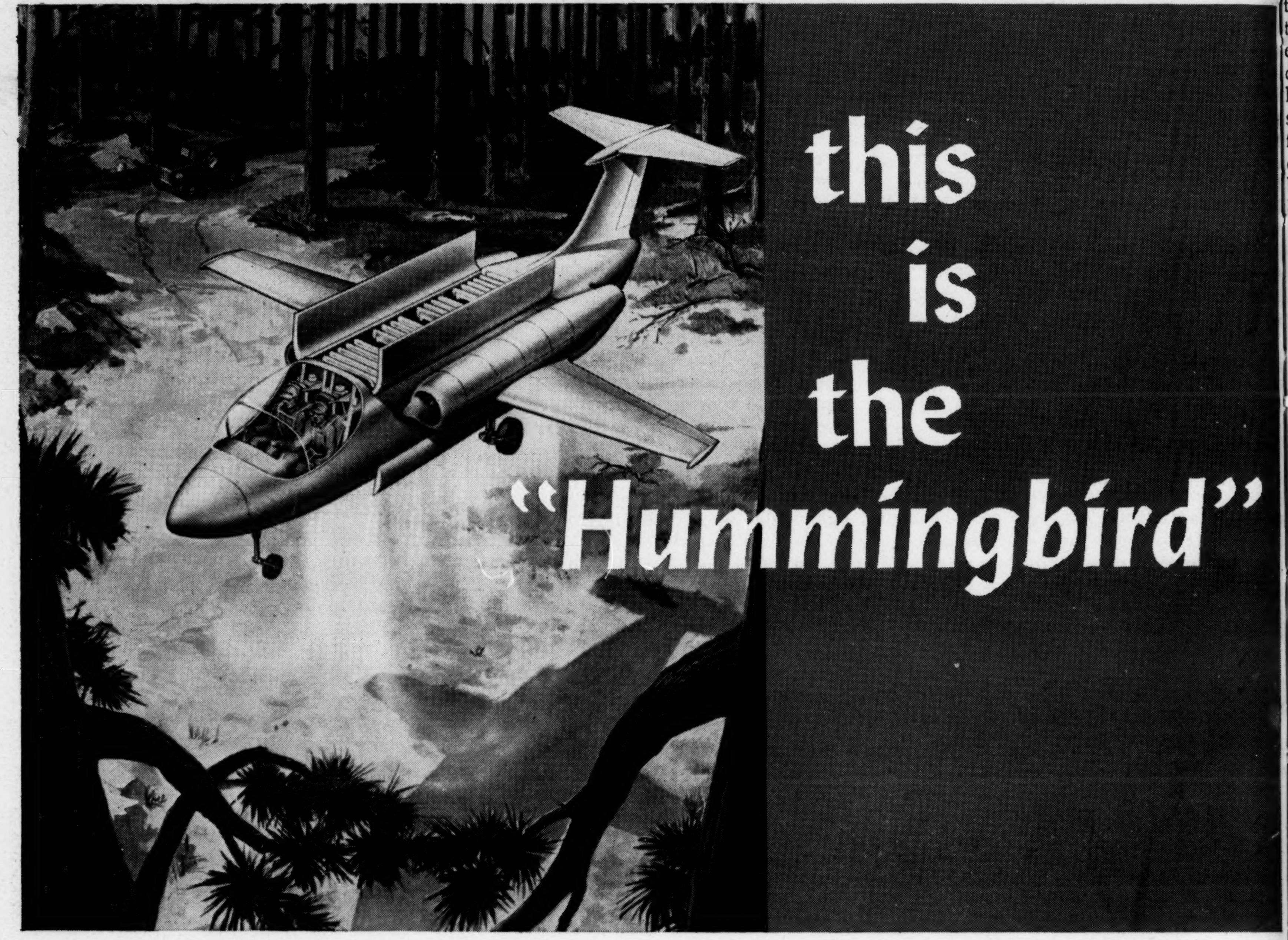
Two airline mechanics witnessed the accident as they were working on a parked aircraft only a short distance away. They jumped on their tug and drove to the scene immediately. They were able to extinguish a fire by the buffet service door and open it. Passengers immediately began using this additional means of egress.

A male passenger (naval aviator) who was seated in the forward end of the aircraft opened an emergency window exit and left

---

[1] All times herein are Eastern Standard and based on the 24-hr. clock.

AIRCRAFT DESIGN ENGINEERS



Engineering is now underway on the strange looking bird pictured here. We call it the "Hummingbird," and we are developing it for the U. S. Army.

It is to utilize the jet ejector augmentation principle for VTOL aerial vehicles to fly straight up, straight down, hover in mid-air, and convert to conventional forward flying at speeds in excess of 500 miles per hour. Just one example of what is going on here at our Engineering Center where dreams come true. Like to join us?

Openings in the fields of: Aircraft Design Engineering • Engineering Drawings Checking • Aircraft Structures • Flutter and Vibration • Sonic Fatigue • Aircraft Specifications Engineering • Reliability Engineering • Operations Research • Aircraft Research Engineering.

Write to: Hugh L. Gordon, Professional Employment Mgr., Lockheed-Georgia Co., 834 W. Peachtree St., Atlanta 8, Ga. Department Z-75.

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

THE ENGINEERING CENTER
LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

through it. As he ran around the nose of the aircraft in the direction of the hangar line he thought of the crew. They were still trapped in the cockpit, being unable to open the windows. This man located the external emergency cable release for the sliding window on the captain's side, actuated it, and helped the crew through the window to safety. Before leaving the accident scene the flight crew, stewardesses, and the two mechanics thoroughly checked the aircraft to be certain all passengers were out. All on board were saved from a situation which at first looked completely hopeless. All 70 passengers and the two stewardesses were able to leave the aircraft in approximately three minutes. Only three of the five available means of egress were used.

Three aircraft were awaiting takeoff clearances at the runway ramp of runway 31 when the accident occurred. The pilots of these aircraft said the approach appeared to be normal except that the aircraft was low when nearing the dike and appeared to settle. One of the pilots stated that he thought this aircraft was so low during the final portion of the approach that it might strike the dike and that he considered trying to warn the pilot by radio but decided against it.

Downdraft Encountered

The consensus of other witnesses was that the approach was normal in that it was neither a steep nor a low drag in approach.

Captain Pangburn testified that he was attempting to land short and that for this type of landing the approach was completely normal until in the last few seconds a downdraft was encountered and the aircraft sank perceptibly. The left wing dropped, and corrective aileron was immediately applied. He said there was insufficient time to correct this by applying power. He further said that the air on final approach was smooth. After turning on final approach, power and airspeed were gradually reduced to 200 hp. per engine and 120 kt. This airspeed was the last called by the first officer just before striking the dike.

The L-188 operating manual recommended airspeed over the airport boundary is 119 kt. for an Electra aircraft weighing approximately 90,000 lb.

The investigation did not reveal any evidence of malfunction or failure of the aircraft or its components prior to ground impact. Company records indicated that this aircraft had been maintained in accordance with prescribed procedures and was in an airworthy condition prior to the accident. Measurements of the propeller blade angles disclosed that they were positioned at approximately 29 deg. Data supplied by the powerplant manufacturers revealed that at this blade angle the engine would be developing 200 hp. at 120 kt. airspeed.

The crew was properly certificated.

Two pilots, whose aircraft landed a few minutes before N 6127A, differed in their statements with respect to turbulence encountered. One, flying a Convair aircraft, said that when approaching LaGuardia he lowered his flaps to 36 deg. instead of 39 deg. (the fully down position) because of turbulence. The other pilot, flying a Beechcraft Travelaire aircraft, said that, "The air was moderately turbulent, a little on the choppy side. It was not excessive turbulence. My only impression is that had my seat belt not been fastened, it wouldn't have made any difference. I never hit any bumps that would have jolted me off my seat. He further stated that just before reaching the dike his airspeed and manifold pressure dropped slightly, accompanied by a mushing feeling, and he applied power as corrective action.

High-Pressure Area

On Sept. 14, 1960, a high-pressure area was centered 350-400 mi. southwest of New York City. This area of high pressure resulted in a flow of air at the surface from a northwest or west-northwest direction from the Virginia-North Carolina border northward through the mid-Atlantic states. On this day there were no fronts affecting the New York City area and the skies were virtually cloudless. Visibilities were unrestricted, ranging from 12 to 15 mi. or more. The surface temperature at LaGuardia at the time of the accident was 57F, and the water temperature approximately 68 deg. During a period of 10 min. prior to and 15 min. after the accident, the recorded straight-line surface wind varied from 17.4 to 21.7 kt. Instantaneous gusts are not shown on this type record. The wind measuring equipment is located on the roof of the control tower. The wind recording element (triple register) is located 86 ft. above the ground, and the anemometer, which is connected to the direct reading dials in both the control tower and the U. S. Weather Bureau office, is located 83 ft. above the ground. The local weather observation, required upon notification of an accident and recorded at 0814, indicated that the sky was clear; visibility 15 mi.; and wind west-northwest 18 kt., with gusts to 24 kt. There were no pilot reports containing wind or turbulence information available for teletype or radio transmission prior to the accident.

Runway 13-31 is 5,347 ft. long and 150 ft. wide. The available length of this runway on the day of the accident was 4,899.5 ft. The decrease in length of 447.5 ft. was necessary because of construction in progress on runway 4-22. The unusable portion was measured from the approach end of runway 13 and was marked by FAA approved marking criteria painted on the runway. Threshold lights were present on both sides of the paved runway surface. The approach plate, dated Aug. 15, 1960, was in the pilot's flight manual and it showed the decreased runway dimensions.

Landing Distance

The company's operations manual shows that for an Electra aircraft weighing approximately 87,767 lb. and landing on runway 31 under the conditions which prevailed Sept. 14, 1960, the minimum effective runway length required is approximately 4,010 ft. This includes crossing the end of the hard surface at a height of 50 ft., flaps in landing position, four engines operating, propeller braking limited to ground idle power, and braking by means of wheel brakes. The above runway length of 4,010 ft. includes a safety factor of 40% of this distance. The actual stopping distance required was estimated to be about 2,500 ft.

TSO-18 (Standards for Determining Obstructions to Air Navigation), a publication of the FAA, prescribes, for an airport the size of LaGuardia, that any obstruction in-

FACT

Flexible Automatic Circuit Tester

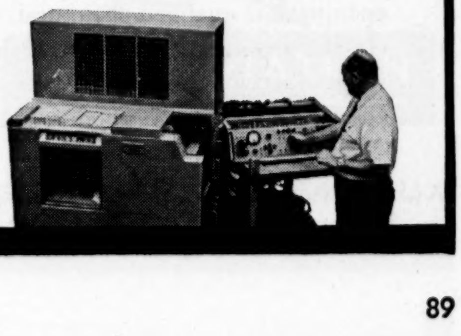
Cut the cost of circuit testing

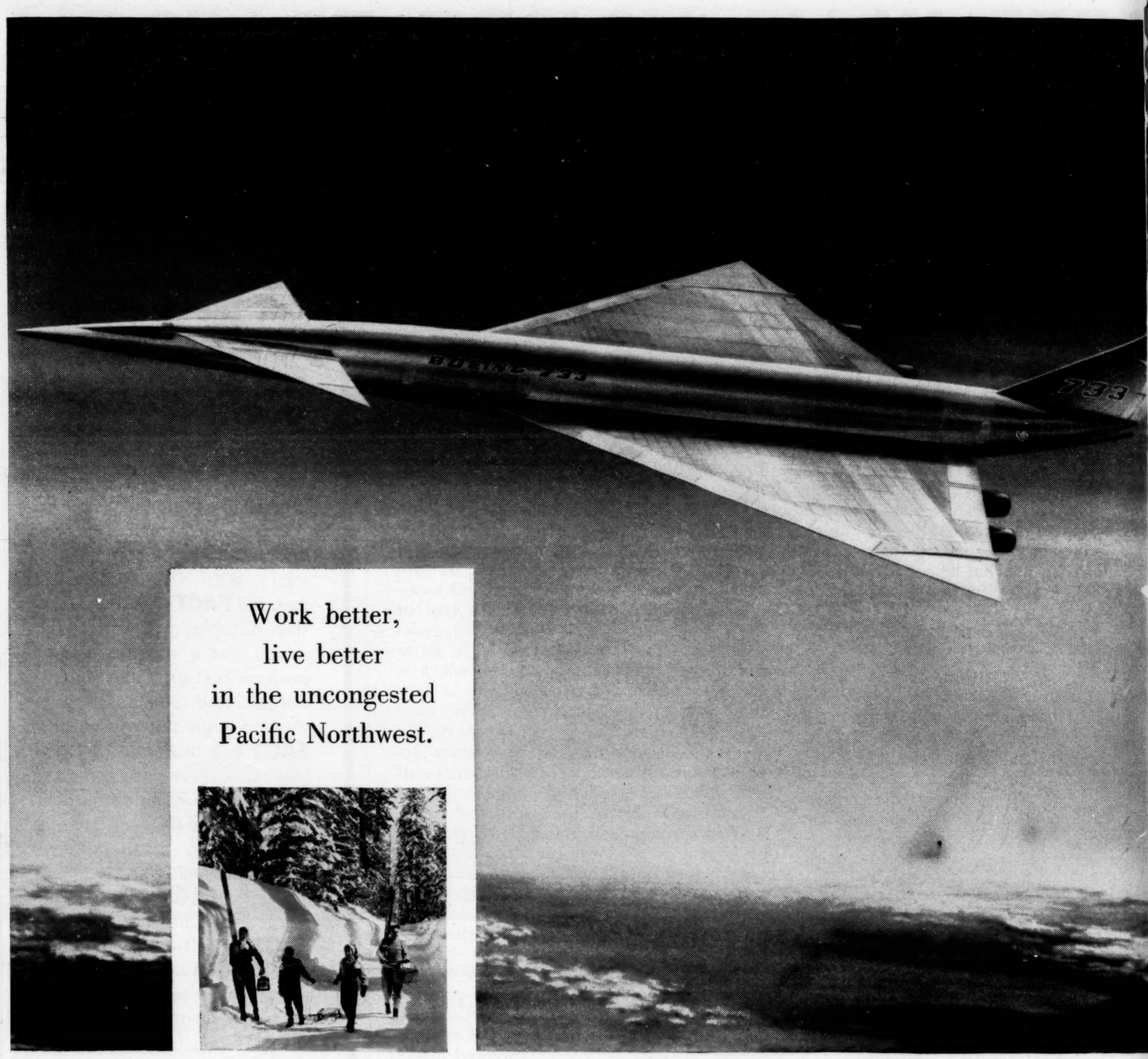
Eliminate the costs of developing special purpose test equipment for each production program! Cut the time required to verify the wiring integrity of electrical assemblies! Reduce the amount of valuable floor space required for circuit testing! □ With the Hughes-developed **FACT**—short for Flexible Automatic Circuit Tester—you get a mobile, *general purpose* test unit that quickly detects and isolates continuity and high potential faults. **FACT** is a high capacity unit—it can program complete tests on an unlimited number of circuits. **FACT** cuts down programming time dramatically—it uses standard IBM systems. **FACT** substantially reduces trouble-shooting time. **FACT** is self-calibrating and self-testing—thereby substantially increasing the confidence level of the circuit test. □ **FACT** is production proven and available today. With three different **FACT** models (2 card programmed and 1 tape programmed) Hughes can meet every circuit testing problem. Inquire today. Write to L. W. Risner, Hughes El Segundo, L.A. 45, California. Or, better yet, call him at ORegon 8-0361. Ext. 1652.

Creating a new world with Electronics

HUGHES

HUGHES AIRCRAFT COMPANY





Design based on Boeing supersonic transport study.

Advanced Boeing programs offer rewarding futures for

STRUCTURAL, MECHANICAL AND AERONAUTICAL ENGINEERS

This supersonic skyliner of the future is one of many advanced projects underway at the Transport Division of Boeing. Other programs offering engineers scope and a chance to grow in professional stature are the new three-engine Boeing 727 jetliner and continuing programs in connection with the famous 707 and 720 jetliners.

Expanding Boeing programs have created openings for qualified structural, mechanical and aeronautical engineers in a wide range of activities in research, development, design, manufacturing and test. Although aircraft experience is desirable, training and assignments are available, on a selective basis, to graduate engineers in other fields who wish to apply their capabilities to aircraft projects.

At Boeing, world leader in multi-jet aircraft, you'll be backed by research facilities unequalled in the industry. And you'll be working in a dynamic career environment that's conducive to rapid advancement.

The Boeing Transport Division is located in the uncongested Pacific Northwest, noted for mild year-round climate, nationally famous recreational facilities, excellent schools and housing, and healthful outdoor Western living for the whole family.

MAIL COUPON TODAY

Mr. Ivan Phillips, Transport Division, The Boeing Company, P.O. Box 707-88A, Renton, Wash. The Boeing Company is an equal opportunity employer.

NAME

ADDRESS CITY STATE

DEGREE(S) HELD

SCHOOL(S), YEAR GRADUATED

FIELD OF INTEREST YEARS EXPERIENCE

TRANSPORT DIVISION **BOEING**

tersecting a glide slope plane of 40-1, shall be identified and marked as an obstruction. Further, that the marking shall consist of red lights on top of the obstacle for night identification, and orange and white checkerboard painting for daytime marking. The manual does not state specifically to what height the daytime marking must extend. The dike near the approach end of runway 31 was marked accordingly; however, these marks lacked reaching the top by approximately three feet.

Analysis and Conclusions

Captain Pangburn said that he was attempting to land short on the runway and would have done so if he had not encountered downdraft approximately 400 ft. horizontally behind the dike, and that this downdraft caused the aircraft to sink rapidly 60 to 80 ft. to a position beneath the top surface of the dike, from which he could not recover. He further said that the aircraft was functioning in a normal manner when the accident occurred.

It is believed that only light turbulence was encountered by Captain Pangburn during the final approach and that a part of this may have been caused by surface wind flowing over the dike, producing a burble or eddy effect. Such an eddy effect, however, is not considered to have been significant in view of the height of the dike, wind velocity, type of aircraft involved, and the pilot's attested familiarity with this type of eddy.

The Board also recognizes that a mental hazard may have been created by the construction work in progress at the end of runway 31 and that this could have furnished the motive for a short landing. Also, the top of the dike was not clearly defined during daylight hours, and this might have provided a margin for error if a pilot were attempting to cross the dike as closely as possible.

Notwithstanding these conditions, the Board believes that a pilot possessing the knowledge and skill expected of an airline pilot should have considered all the existing conditions, allowed for them in planning the approach, and thus have avoided striking the dike by crossing it at a safer altitude.

As a result of this investigation and hearing, two recommendations were sent to the Federal Aviation Agency.

1. On Sept. 22, 1960, it was recommended that the "Visual Glide Slope System," then undergoing tests by the FAA, be applied to LaGuardia Airport as soon as practicable.
2. On Dec. 13, 1960, it was recommended, in a letter to the Administrator, that the present procedures for providing illumination of passenger exit markings be re-examined.

Probable Cause

The Board determines that the probable cause of this accident was the failure of the pilot to properly plan and execute the approach to a landing. Factors which may have contributed were the shortened runway and the unmarked upper portion of the dike. By the Civil Aeronautics Board:

Alan S. Boyd, Chairman;
Robert T. Murphy, Vice Chairman;
Chan Gurney, Member;
G. Joseph Minetti, Member;
Whitney Gillilland, Member.

The Civil Aeronautics Board was notified of the accident immediately after it occurred. An investigation was immediately initiated, in accordance with the provisions of section 701(a)(2) of the Federal Aviation Act of 1958. Depositions were ordered by the Board and taken in New York, N. Y., Oct. 19 and 20, 1960, and in Washington, D. C., Nov. 21, 1960.

American Airlines, Inc. is a Delaware corporation with its principal office in New York, N. Y. The carrier holds a certificate of public convenience and necessity issued by the Civil Aeronautics Board, and an air carrier operating certificate issued by the Federal Aviation Agency. These certificates authorize the carrier to engage in air transportation of persons, cargo, and mail within the United States, including the route involved.

Crew Qualifications

Captain Sheldon E. Pangburn, age 47, was employed by American Airlines on Nov. 25, 1941. He held a currently effective airline transport pilot (airplane) rating certificate with the following ratings: single and multi-engine land, DC-3, DC-4, DC-6, DC-7, CV-240, CV-340, CV-440, and L-188 aircraft. He had a total flying time of 14,082 flying hours of which 279 were in Lockheed Electra aircraft. He passed his last FAA first-class medical examination Apr. 27, 1960.

This medical certificate included a waiver specifying corrective lenses for near vision.

Captain Gordon E. Staples, age 47, was employed by American Airlines on July 11, 1940. He held a currently effective airline transport pilot (airplane) rating certificate with the following ratings: single and multi-engine land, and DC-3, DC-4, DC-6, DC-7, CV-240, CV-340, CV-440, and L-188 aircraft.

He had a total flying time of 18,310 hr. of which 460 were in Electra aircraft. He passed his last FAA first-class medical examination Mar. 14, 1960.

First Officer Herbert E. Schleicher, age 38, was employed by American Airlines on June 18, 1951. He held a currently effective airline transport pilot (airplane) rating certificate with the following ratings; single and multi-engine land, CV-240, CV-340, and L-188 aircraft. He had a total flying time of 7,550 hr. of which 300 were in Electra aircraft.

His last FAA medical examination was successfully taken Dec. 25, 1959.

Flight Engineer Kenneth F. Thoman, age 36, was employed by the company Mar. 12, 1951. He held a currently effective flight engineer certificate. His total flying time was 7,600 hr. of which 320 were in Electra aircraft.

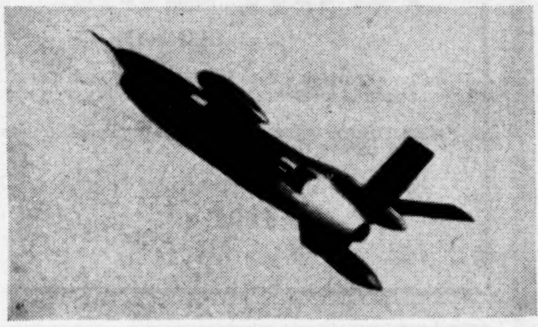
He passed his last FAA medical examination Feb. 26, 1960.

Stewardesses Donna Gilligan and Margaret Fleming were properly qualified and each had accumulated 760 and 837 flying hours, respectively, in company service.

The aircraft was a Lockheed Electra, Model L-188, serial No. 1117. It was manufactured Jan. 21, 1960, and had accumulated 1,573 flying hours. It was equipped with four Allison engines, Model 501D13, and four Model A-6441 FN-606 propellers manufactured by Aero Products, Inc.

NORD-AVIATION
Ordnance
Research
Development

CT-20 TARGET DRONE
SIX RECOVERABLE FLIGHTS



Nord's CT-20 is zero length launched and radio controlled. These drones have averaged six flights, recoverable in the sea as well as on land. Simplicity of design and operation, plus maximum reuse, represent cost savings.

MAIN CHARACTERISTICS

Speed at 32,800 ft.	560 m.p.h.
Time to 32,000 ft.	6 min.
Mean endurance	45 min.
Service ceiling	40,000 ft.
Take-off weight	1,470 lbs.
Span	11.15 ft.
Length	17.71 ft.
Diameter of fuselage	2.16 ft.
Wing area	34.34 sq. ft.

NORD-AVIATION
2-18, rue Béranger
CHATILLON-SOUS-BAGNEUX
(Seine) France

NATIONAL
COVERAGE

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant	**Civil Service Opportunities**	**Employment Agencies**
Positions Wanted	**Selling Opportunities Wanted**	**Employment Services**
Part Time Work	**Selling Opportunities Offered**	**Labor Bureaus**

———RATES———

DISPLAYED

The advertising rate is $60.20 per inch for all advertising appearing on other than a contract basis. Frequency rates quoted on request.

An Advertising inch is measured 7/8" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

UNDISPLAYED

$2.70 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.
Position Wanted Ads are ½ of above rate.
Box Numbers—counts as 1 line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.
Not subject to Agency Commission.

Send NEW ADS to Classified Advertising Div. of AVIATION WEEK, P. O. Box 12, N. Y. 36, N. Y.

LIVE in Sunny San Diego!

New and expanded programs have created immediate R & D openings for

EXPERIENCED ENGINEERS

in the fields of

TURBOMACHINERY AND HIGH TEMPERATURE MATERIALS

Gearing Design Engineers
Turbomachinery Design Engineers
Mechanical Design Engineers
Fuel Controls Systems Engineers
Heat Transfer Engineers
Metallurgists
Physical Chemists
Ceramics Engineers

SOLAR SPECIFICS: Solar is making many significant contributions to turbomachinery design and high temperature materials. There is an excellent balance between commercial and military contracts.

WONDERFUL LIVING: San Diego living is great, offering the nation's finest year-round climate and recreation, education, and cultural advantages.

WRITE TODAY: Send resume of your qualifications to Louis Klein, Dept. E-742, Solar Aircraft Company, 2200 Pacific Highway, San Diego 12, California.

SOLAR

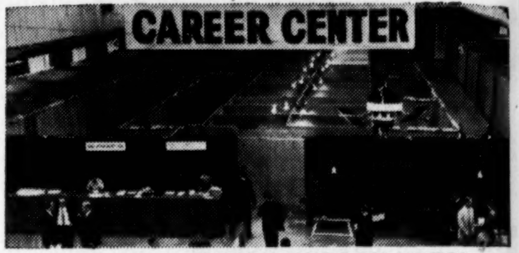
A subsidiary of International Harvester Company

2200 Pacific Highway, San Diego 12, California

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

EMPLOYERS SPONSOR CAREER CENTER

Interview Engineers in New York, October 10-13



LOCATION: **HENRY HUDSON HOTEL**
358 W. 58th St. (opp. Coliseum)
PHONE: CIrcle 6-5015
TIME: 10 A.M. to 9 P.M. daily
Registration is free and confidential.
No charges at any time.

CAREER CENTER®

Career Centers are a service of
Careers Incorporated,
770 Lexington Ave., New York 21, N. Y.

ADVANCE REGISTRATION: OCT. 8 & 9 AT THE HENRY HUDSON!

SOPHISTICATED ENGINEERS

A NEW STATE OF THE ART

We have succeeded in the development of an entirely new concept for the SUCCESSFUL placement of qualified engineers and scientists. We now have in excess of 4,000 openings in the $8,000.00 to $60,000 bracket. Never a charge to applicant. For confidential consideration submit resume in duplicate indicating geographical preference and salary requirements.

BERRY ASSOCIATES, INC.
1014-15 Commercial Trust Building
Philadelphia 2, Pa.
Locust 3-6654

SALES ENGINEERS

Established manufacturer of FAA approved replacement parts requires Sales Engineers for Mid-Western U. S. Applicants should have extensive aviation sales experience and working technical knowledge of current aircraft powerplants. Send resume to Box

P-7575, Aviation Week.
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

NEED ENGINEERS?

An employment advertisement in the EMPLOYMENT OPPORTUNITIES SECTION will help you find the engineers you need. It's an inexpensive, time-saving method of contacting competent personnel for every engineering job in the Aviation industry. The all paid circulation of AVIATION WEEK offers you an opportunity to choose the best qualified men available.

For rates and information write:

CLASSIFIED ADVERTISING DIVISION

AVIATION WEEK

P. O. Box 12 New York 36, N. Y.

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, OCTOBER 2, 1961

AEROJET-GENERAL CORPORATION........2nd Cover
AEROSPACE CORPORATION 3
AIRCRAFT ARMAMENTS, INC. 78
AMP INCORPORATED 66
AMERICAN BOSCH ARMA CORPORATION, ARMA DIVISION 4
AVCO CORPORATION ....4th Cover
BENDIX PACIFIC DIVISION, THE BENDIX CORPORATION 85
BENDIX PRODUCTS DIVISION, THE BENDIX CORPORATION 54
BOEING COMPANY, THE—TRANSPORT DIVISION 90
CHERRY RIVET DIVISION, TOWNSEND COMPANY 6
CLIFTON PRECISION PRODUCTS COMPANY, INC. ....3rd Cover
DATA CONTROLS SYSTEMS, INC.............. 5
DEUTSCH COMPANY, THE—HYDRAULIC COMPONENTS 56
GENERAL ELECTRIC COMPANY, FLIGHT PROPULSION DIVISION 8-9
THE B. F. GOODRICH COMPANY, AVIATION PRODUCTS DIVISION 79
HAWKER SIDDELEY AVIATION LIMITED....... 48
HI-SHEAR CORPORATION 68
HUGHES AIRCRAFT COMPANY 76-77, 89
INTERNATIONAL BUSINESS MACHINES CORPORATION, DATA PROCESSING DIVISION. 58-59
LIBRASCOPE DIVISION, GENERAL PRECISION, INC. 24
LING TEMCO VOUGHT 97
LITTON SYSTEMS, INC., DATA SYSTEMS DIVISION 69, 84
LOCKHEED GEORGIA COMPANY A DIVISION OF LOCKHEED AIRCRAFT CORPORATION 16-17, 88
LOCKHEED MISSILES & SPACE DIVISION, LOCKHEED AIRCRAFT CORPORATION........ 20
MARQUARDT CORPORATION, THE............10-11
McGRAW-HILL BOOK COMPANY, INC........... 81
MOTOROLA, INC., MILITARY ELECTRONICS DIVISION 12
NORD AVIATION 91
NORTHROP CORPORATION 86
PRATT & WHITNEY AIRCRAFT DIVISION, UNITED AIRCRAFT CORPORATION..........50-51
RADIO CORPORATION OF AMERICA, ELECTRON TUBE DIVISION 62
RAYTHEON COMPANY, AERO-WEAPONS DIVISION 72-73
ROCKET POWER INC. 82
SELENIA, S.P.A. 80
SHELL OIL COMPANY, AVIATION PRODUCTS... 40
SINCLAIR REFINING COMPANY 44
SPERRY GYROSCOPE COMPANY DIVISION OF THE SPERRY RAND CORPORATION 15
SYLVANIA ELECTRIC PRODUCTS, INC., SPECIAL PRODUCTS DIVISION.................. 49
TAPCO GROUP, THOMPSON RAMO WOOLDRIDGE, INC. 13
TEXAS INSTRUMENTS INCORPORATED, APPARATUS DIVISION........................... 22
THIOKOL CHEMICAL CORPORATION...........64-65
UNITED STATES STEEL CORPORATION......... 14
VICKERS INCORPORATED DIVISION OF SPERRY RAND CORPORATION, MARINE & ORDNANCE DEPARTMENT 18
WESTINGHOUSE ELECTRIC CORPORATION, DEFENSE PRODUCTS GROUP 7

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

WHERE TO BUY
  Harris Mfg. Co., Inc. 96
EMPLOYMENT OPPORTUNITIES................92-95
EDUCATIONAL
  Books 96
EQUIPMENT
  (Used or Surplus New)
  For Sale 96

ADVERTISERS INDEX

Barry Associates 92
Boreas Corporation 96
Cape Canaveral Sales Co. 96
Careers, Inc. 92
Cornell Aeronautical Lab., Inc............... 95
Currey Sanders Aircraft Co., Inc............. 96
Dee Co. 96
McDonnell Aircraft Co. 94
Pratt & Whitney Aircraft 93
Radio Research Instrument Co................. 96
Solar Aircraft 92
Stoltzfus Agency, Chris D.................... 96

take a GIANT step now!

Now is the opportune time to take part in history-making programs at Chance Vought in Dallas. Rapid expansion in Vought's Aeronautics and Astronautics divisions has created excellent opportunities for career growth. Engineers and scientists who qualify will be given key responsibilities in military, commercial and aerospace programs. Opportunities exist in these areas:

- **aerodynamics — thermodynamics**
- **analog — digital programing**
- **astrionics — avionics**
- **conceptual design — product design**
- **electronics systems**
- **flight test engineering**
- **instrumentation**
- **metallurgy — ceramics**
- **meteorology**
- **operations analysis**
- **propulsion — power systems**
- **reliability — maintainability**
- **space technology**
- **structures — dynamics — stress**
- **welding engineers**

REQUIREMENT:

engineering or related degree and a minimum of 3 years direct industry experience. All qualified applicants will be considered without regard to race, creed, color or national origin.

PLEASE SUBMIT RESUME TO:
PROFESSIONAL PLACEMENT

CHANCE VOUGHT
A SUBSIDIARY OF
LING-TEMCO-VOUGHT, INC.
P.O. BOX 5907, DALLAS 22, TEXAS

LETTERS

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Rotor Blade Failure

We wish to commend the Civil Aeronautics Board for its excellent detailed Accident Investigation Report of the Sikorsky S-58C helicopter crash of July 27, 1960, and your magazine for publishing this report in its issue of Aug. 28, 1961 (p. 102).

It is through widespread dissemination of the possible causes of such accidents that intelligent action can be taken to eliminate potential trouble areas and faulty procedure.

We were particularly interested in the CAB's opinion that, in view of the catastrophic nature of a main rotor blade failure and the demonstrated fact that a fatigue crack can develop and progress to failure in less than 68 hours, that detailed inspection should be spaced at shorter intervals. We would like to make known to FAA and industry a possible solution to spotting blade fatigue.

The Kollmorgen Corp. has designed a compact, self-propelled flow camera which can traverse the rotor blade cavity. The camera is of modular construction, employing plug-in illumination, viewing optics, film transport, and propulsion unit. A continuous image is presented on 35 mm. film with resolution of the camera more than sufficient to see such defects and hair-line cracks smaller than .010 in.

This camera has a decided advantage over the present method of inspection usually conducted with a borescope. The borescope method is a rather tedious process, and ineffective, since there is likelihood that defects will be overlooked. The Kollmorgen design in addition to its superior resolution offers a permanent record.

We would be pleased to answer any questions from interested personnel in the government and industry manufacturers.

Once again please accept our thanks for your continuing efforts to make air travel safe for all.

Zachary Fortunato
Assistant Sales Manager
Kollmorgen Corp.
Northampton, Mass.

Mach 3 Economies

Capt. William L. Polhemus poses some penetrating questions in his letter on the supersonic transport program in the Sept. 11 issue of Aviation Week and Space Technology (p. 126). Similar questions were raised at the IATA SST symposium in Montreal during April of this year, and the FAA has no doubt deliberated at length on many of these. Few of these questions can be answered to our complete satisfaction by clear-cut technical analysis. Strong areas of black and white are rare; the predominant color is gray. Some questions fall in the province of policy, rather than of technology or economics

For example, the major question raised by Capt. Polhemus, that of SST cruising speed, has strong implications in technology and economics. But the real decision is one of policy. The FAA has repeatedly stated its conclusion that the most value to national prestige will be gained, not by offering the first SST, but by producing the best one. As a corollary, FAA has concluded that the "best" airplane is in the Mach 3 category; that is, that Mach 3 will provide the "best" service for the customer, "best" economics for the operators, "best" investment for the nation, etc. True, these conclusions lie within the gray areas.

A decision for an early SST would be favorable to General Dynamics. Experience at Mach 2.0-2.4 with the F-106, and particularly with the B-58, would be especially valuable in building the first SST, almost certain to fall in the Mach 2.0-2.4 category. But the "gray area" analyses indicate that a Mach 3.0-3.2 airplane probably will have lower direct operating costs than any Mach 2.0-2.4 airplane. Aluminum structure has a highly questionable service life at Mach 2.0-2.4; steel and titanium are considerably more promising at Mach 3.0-3.8 than aluminum at the lower speeds. While the aluminum airplane may have a service life of some 10,000 hours, anything less than 20,000 hours will be an economic albatross to the airline depreciation schedules.

Although the Mach 2 airplane is generally expected to be smaller than the Mach 3 SST, the slower airplane may create a greater sonic boom on the ground than the larger, faster airplanes. The Mach 3 SST will cruise at appreciably higher altitude and this altitude difference is predicted to be more powerful than the combined size-speed advantage of the smaller, slower airplane.

Pending results of this year's supersonic boom flight tests being conducted jointly by FAA/NASA/USAF, the FAA has tentatively established a minimum altitude limit of 41,000 ft. for supersonic flight. It is doubtful that an economical Mach 2.0-2.4 SST is capable of subsonic climb to 41,000 ft., followed by acceleration to supersonic speeds; it is virtually certain that an early Mach 2.0-2.4 airplane cannot do this. And, if it should be concluded that supersonic flight below 41,000 ft. will not create an unacceptable boom at the ground, the problem of intermixing subsonic and supersonic traffic at the lower altitudes could well disqualify supersonic operation below the present tentative limit.

Either of these questions, fatigue life of aluminum at elevated temperature or supersonic acceleration altitude capability, could render the Sud Aviation venture a complete failure. In addition, economic studies indicate that SSTs of much less than 100 passengers will be uneconomical at all speeds and ranges (at standard fares). Admittedly, all these conclusions are in the gray areas. But the strength of the evidence is in favor of the larger, faster airplane.

One may reach, however, a strong, positive conclusion from the analytical experience to date. Thumbnail comparisons, back-of-the-envelope studies, and rapid-ratio conclusions can be highly misleading. There are simply too many variables, technical, operational, economic and financial which effect the total SST picture. As we gain more experience background and more extensive computer programs, together with results from the planned flight tests, many of the grays will become distinctly black or white.

In the meantime, due to the current heavy excess of airline seat space, with more subsonic airplanes being delivered daily and more on order, it is doubtful that the airlines will urge development of an early SST. True, a successful Super Caravelle might stampede the airlines prematurely and amputate an important segment of the SST market; a large Soviet SST might have equally serious, even fatal, effects on the limited total market for SSTs. But, unless the airlines, the FAA or the Congress specifically request it, is is unlikely that further intensive U. S. attention will be directed at the Mach 2.0-2.4 area.

Charles L. Blake
Transport Systems
Development Manager
General Dynamics Corp.
San Diego, Calif.

On Haystack Hill

Thanks for the fine play you gave our Haystack Hill picture on the cover of the Aug. 21 issue of Aviation Week and Space Technology. The caption on the index page, however, confused construction of the Electronic Systems Division's 150-ft. radome with the antenna that will go inside.

The radome is composed of 930 triangles of glass-fibre-reinforced plastic membrane $\frac{1}{32}$nd of an inch thick. Your caption referred to $\frac{1}{2}$ inch thick aluminum honeycomb, which is the surface of the 120 ft. wide reflector.

Col. John D. Nottingham
Director of Information
Electronic Systems Division
Air Force Systems Command
Laurence G. Hanscom Field
Bedford, Mass.

Hypergolic Fuels

Several illustrations of the Titan II engines are pictured on p. 75 of your Sept. 11 issue, with an accompanying caption that terminates with the sentence, "Flame pattern of hypergolic fuels is more translucent than that of cryogenic propellants."

Lest anyone receive the mistaken impression from this statement that cryogenic propellants, per se, are non-hypergolic, I think it would be appropriate to qualify your statement somewhat. While liquid oxygen does require a separate ignition system, liquid fluorine is indeed hypergolic with any storable or cryogenic fuel, in addition to being significantly more energetic.

J. P. Greiten
West Coast Representative
Bell Aerosystems Co.
Los Angeles, Calif.